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## CONTENTS:


| | PAGE |
|---|---|
| Telephones and Municipalities ... ... ... ... ... | 253 |
| Hints on Arc Lamps ... ... ... ... ... ... ... | 254 |
| World's Fair Electrical Plant (*concluded*) ... ... ... | 256 |
| A Mechanical Effect of Very Rapid Electric Oscillations (*illus.*) | 258 |
| Electrical Engineering at the World's Fair.—X. (*illustrated*) ... | 259 |
| Meldrum's Improved Furnace (*illustrated*) ... ... ... | 259 |
| The Moment of Reversal in the Quadruplex Neutral Relay—the Wicks Arrangement ... ... ... ... ... ... | 261 |
| An Improved Arc Light (*illustrated*) ... ... ... ... | 261 |
| Correspondence:—Ampère's "Swimmer" Rules... ... ... | 262 |
| Modern Gas and Oil Engines ... ... ... ... ... | 262 |
| Notes ... ... ... ... ... ... ... ... ... | 263 |
| Business Notices, &c. ... ... ... ... ... ... | 269 |
| City Notes:— | |
| The Direct Spanish Telegraph Company ... ... ... | 270 |
| Traffic Receipts ... ... ... ... ... ... ... | 270 |
| Share List of Electrical Companies ... ... ... ... | 271 |
| Incandescent Lamp Tests ... ... ... ... ... ... | 272 |
| The Utilisation of Town Refuse for Power Production (*illustrated*) (*continued*) ... ... ... ... ... ... ... | 272 |
| Review:— | |
| Griffin's Electrical Price Book ... ... ... ... | 274 |
| Test of a Triple Expansion Engine ... ... ... ... | 275 |
| The use of Cupric Nitrate in the Voltameter, and the Electro-chemical Equivalent of Copper ... ... ... ... ... | 275 |
| Telephones and the Glasgow Corporation... ... ... ... | 276 |
| New Patents ... ... ... ... ... ... ... ... | 277 |
| Abstracts of Published Specifications ... ... ... ... | 277 |


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## TELEPHONES AND MUNICIPALITIES.

ONE of the prominent characteristics of present-day politics is the extension of municipal work. The activities of local governing bodies are no longer limited to carrying on the duties of a Turnpike Trust and a Commission of Sewers. "We are all Socialists now," and the municipality not only provides a refuge for its submerged, but adds a lodging-house for its floating, population. Between the two extremes of roads and refuges are numerous duties undertaken by a corporate body for the benefit of its citizens. And the tendency grows. Amongst the duties which are universally recognised as appropriate to municipal work are the supply of water, gas, and electric light. All these services utilise the streets for the distribution of their mains, but as yet telephones do not. The Joint Committee have, however, recommended that statutory powers be granted to "telephone undertakers" with a view to facilitate the introduction of a metallic circuit system. Municipalities are jealous of their highways. The people of Glasgow feel very keenly on the point, and are determined that no outside company, nor even a department of the Government, shall come in and control their streets. So said the spokesman of a deputation from the Glasgow Town Council, who waited upon the Postmaster-General for the purpose of urging upon him that no agreement should be come to between the Post Office and the National Telephone Company which would empower that company to open up the streets of Glasgow for the purpose of laying wires, and that the Glasgow Corporation should be granted a license to work the telephone within the city.

The Glasgow Corporation has advantageously undertaken many useful and beneficial works, and their request to maintain the powers over their streets and to supply a telephone service seemed very moderate and reasonable. In submitting their application to a member of a Government which makes the extension of local powers a feature of its policy, they were justified in expecting that a favourable response was not an impossible contingency. As to the streets, Mr. Arnold Morley intimated that the rights of the Corporations will be left absolutely undisturbed, and that they are regulated by Act of Parliament. On the subject of a license he gave no definite decision; but in his remarks he made it clear that the telephone is not strictly municipal business, but a distinct branch of the telegraph system, which is part of the business of the State.

In a letter to the *Times* of the 4th inst., Mr. Henniker Heaton states that the members of the deputation bitterly complained of the unsatisfactory character of the interview, and we have received from the convener of the Telephone Committee of the Glasgow Corporation a "memorandum," drawing attention to the subject, and seeking, by a joint movement, to prevent the proposed agreement being con-

cluded with the National Telephone Company, otherwise "local authorities will find themselves hampered in their work, and the community saddled in perpetuity with a liability to pay charges calculated on the enormous capital created by the National Telephone Company, only a part of which has been expended on plant and property."

That the Corporation should be disappointed is inevitable, and the attitude assumed by the Postmaster-General will certainly be unpopular in many quarters. But Mr. Arnold Morley's views are sound, and they will doubtless prevail against the agitation which seems to be in progress amongst municipal bodies.

The Corporations and the Postmaster-General regard the subject from different points of view. The Corporations look at the material part of it, the pipes, the wires, and their bearing on the streets. The Postmaster-General looks at the service which is rendered, and there is no doubt whatever that a broad view of the telephone service of the future will show it to be unsuitable for municipal management. It would be very much easier for the Glasgow Corporation to undertake post office duties than to carry on satisfactorily the telephone work of the future.

Unfortunately, in their opposition to the Telephone Company, the Glasgow Corporation adopt the same line of argument as that to which we have become accustomed from less responsible bodies. Telephones are cheap in Stockholm; and only a part of the National Telephone Company's capital has been expended on plant and property. "Full information in respect to the Stockholm telephones is in possession of the Postmaster-General, who is therefore well aware of what can be done with perfect ease in our cities." This argument is illogical. Even supposing that the favourable conditions exist in Stockholm, there is no evidence to show that "therefore" they are equally applicable here. The Postmaster-General has exchanges of his own, and can obtain information at first hand. If Stockholm information is to be given to the public it should all be given to the public. It should be known that in that city "a keen competition" exists between the private company and the government, and according to the consular reports referred to, "it is anticipated that the state department will under-bid the old company, and gradually take over its subscribers." From the same sources may be seen evidence which should make the Glasgow Corporation consider its position. It proposes to enter into competition with the local company. The consul's report from Christiania records that two competitive systems existed there, and states that "greater and greater inconvenience resulted to the public from the existence of two disconnected telephone systems. . . . Their amalgamation into one company was at last effected by pressure on the part of the municipality." Who would exercise the pressure when the municipality was a competitor?

The reference to the inflated capital of the National Company is excusable enough, but it has been utilised too often. The Glasgow Corporation assert that a cheap and efficient telephone service is absolutely necessary in Glasgow. Now who showed Glasgow the utility of a telephone service at all, except the telephone company; and when that company embarked upon the business, did the Glasgow Corporation guarantee a dividend on its outlay, or did the company incur a risk with the prospect of profit? The simple fact is that the telephone business was undertaken as a commercial speculation, and has been continued as such, and the inflated capital represents the public view of the success which has attended the venture. The capital is nominal not actual. If the position the company has attained enables it to earn a dividend upon the capital, it is entitled to the reward of its enterprise. The Telephone Company has secured a virtual monopoly at present, and is using its position for the purpose for which it was started—dividends. It has, so far, succeeded. We have never heard that its success has been attributed to an excess of public spirit or to super-excellent management. Many of those who have not participated in its success have been disposed to "have their revenge by railing at it," as Montaigne said of greatness.

The Glasgow Corporation complain that the Telegraph Act was rushed through at the end of last session. They complain that the capital of the National Company was still more increased last year in connection with obtaining the control of the New Telephone Company. The Glasgow Corporation complain too late. They should have acted at the time. Sir John Lubbock stood alone in Parliament, and we were alone in the Press in protesting against the rapid passing of that Act. We foresaw the result, and said so. The self-styled advocates of cheap telephony, and the railing opponents of grinding monopolies were unaccountably lulled to acquiescence in a scheme which gave no public advantage whatever, made the monopoly more complete than before, added to inflated capital, and gave certain promoters handsome profits. This resulted from Parliamentary and other agitation. Under these circumstances we cannot profess any regret that the Postmaster-General declines to lay the agreement with the Telephone Company upon the table of the House before signature. The subject is one which must be discussed with knowledge, and it is probable that Mr. Morley will make a better bargain for Parliament than Parliament could make for Mr. Morley.

The want of information as to the true nature of telephone business, and an inclination to believe that any proceedings, just or unjust, may be adopted against an unpopular monopoly, are at the root of the telephone difficulty. When previously discussing the subject, we said the only alternatives were free trade or Government purchase, and we think they remain so still.

## HINTS ON ARC LAMPS.

NOT long since a well-known writer in an engineering contemporary remarked that there is no mechanism used in electric lighting so little studied as the arc lamp, and that the alternating current lamp has received even less attention than its direct current prototype, so it is quite time engineers studied these apparatus seriously, designed them to suit modern distribution systems, and arranged them to burn cheap carbons without pumping, and without getting out of order. A great future has been prophesied for arc lamps, and it is certainly curious that the arc is least used in the only country where the incandescent lamp is expensive.

Judging from a letter which appeared in our last issue, there exists some uncertainty about the working of arc lamps, even when they are properly designed and put in

circuit, and there is still greater ignorance shown with regard to the light which can be obtained from them. Although the number of arc lamps which have been invented is legion, we might almost count those which monopolise the market on the fingers of one hand. And yet if one well known firm can command a sale of something like 2,000 arc lamps per annum, it seems that there is an ample field for competition if the right article be only forthcoming, for every new central station opened throughout the country brings with it a demand for arc lamps. The fact is, that there is but little known of arc light practice and the essential qualifications for a practically and commercially successful lamp, except amongst the favoured few who have laboured for the past decade in this special branch of the electro-technical industry. Even amongst the inventors themselves we feel that it is well within the truth to say that 75 per cent. of them have not grasped, or even understood, all the factors which are involved in the problem of practical arc lighting in all its varying phases. To design an arc lamp which shall flare away in the inventor's workshop or laboratory, and which will probably give, under his own immediate supervision or that of a trustworthy workman, a pleasing light for the few minutes necessary to bring it before the eyes of people who may be invited to inspect it with a view to business relations, is an easy matter; to design and place upon the market a lamp which shall satisfy all the conditions of arc light practice, and under all the trying circumstances of rough usage, weather, unskilled handling, and uncertain supply, is a different thing.

But it is not so much to the designers or would-be inventors of arc lamps that we intend our remarks to apply, as to those people who are now exploiting, or who may eventually be engaged in exploiting wild-cat schemes for arc lamps, with which the electrical atmosphere is teeming.

The majority of commercial men seem to be under the impression that so long as an arc is formed by a simple piece of mechanism, that is all one requires. But for a lamp to stand a legitimate chance of being adopted to any extent in general arc lighting, it must possess several very important, and not always readily attainable merits, but without which it is practically useless to proceed further. To compete with those mostly in use at the present day in this country in ordinary every day work, a lamp worked in series on a constant current circuit should not show a variation of more than 4 per cent. in the voltage at its terminals, nor should a lamp used in parallel on a constant pressure circuit allow of more than 10 per cent. variation in current. And an expert testing a lamp would probably insist on variations of not more than half these figures in lamps submitted to him to be reported upon. These essential features of a marketable arc lamp should be the guiding star of the inventor, and the safeguard of any syndicate or company promoter who is on the look-out for a good thing.

But as these tests are not understood outside the trade, it is easy enough, by the exercise of a little ingenuity, to persuade the uninitiated that a thoroughly bad lamp is a first-rate regulator. How many people, exclusive of arc lamp experts, would, if shown a single arc lamp burning apparently steadily, and feeding with sufficient regularity to prevent the extinction or short-circuiting of the arc, ask any questions beyond enquiring the voltage at the lamp terminals and the current passing? Few would stop to investigate the circuit on which the lamp was placed; but upon this investigation much depends.

A lamp, taking current from a machine giving, say, 120 or 130 volts at the brushes, and having a resistance in circuit sufficient to bring down the pressure to 45 volts at its terminals, may be made to assume a virtue, if it has it not. In other words, lamps, which, on a 50 or 55-volt circuit will not regulate within these limits, may be made to show very fair results, so far as light is concerned, by being placed on a high voltage circuit with a big resistance to steady the current. In approved regulators the arc is controlled by the fall of pressure over a very small resistance, not exceeding 10 per cent. of the resistance of the arc; thus two lamps should work in series on a 100-volt city circuit.

The introduction of great resistance is costly, for the electrical energy consumed in the idle resistance may be much in excess of that utilised in the arc itself, but it has to be paid for just the same.

The wild and extravagant notions which exist in many quarters regarding the luminous power of the arc are still more extraordinary. It is not at all uncommon to hear that the lamp invented by Mr. A will, with equal current, give double the light of that devised by Mr. B, or quite as much with half the current. Now, assuming carbons of the same length, diameter, and of the same quality, then with E.M.F. and current equal, the two lamps, if their feeding mechanism acts properly, will give exactly the same light. But it is possible that one lamp, through bad feeding, may give less light than its better regulated companion, even when taking a much larger current, or the same effect may happen if one of them is deliberately placed on a circuit for which it was never intended, but which just suits the other. These differences in the actual conditions of burning are carefully concealed from the would-be speculator, and he is led from his own observations, in addition to what he is told, or, rather, from what is left unsaid, to believe that there is as much difference between one 10-ampère lamp and another, as between an ordinary gas jet and an improved argand burner. The mechanism of arc lamps cannot control the physical laws of the arc in any way whatever; it can only feed the carbons as they consume, so the notion that any type of regulator at the same voltage, and taking the same current as another, other things being equal as previously mentioned, will show marvellous differences in illuminating power, is simply preposterous. A particular make of lamp may consume a trifling percentage of electrical energy, say 1 or 2 per cent. more than one of another design, but the excess is lost in the coils or regulating resistance, and is too insignificant to seriously entertain as affecting the respective merits of the approved lamps.

When one considers that the circuits of public supply are usually of 100 to 110 volts, it shows the necessity for good regulators used in multiple series; to burn single lamps with a resistance in circuit big enough to cut down the pressure to 45 volts, simply means paying for 100 units, receiving 45 and losing 65; yet we know of instances in which it is gravely proposed to do so, in the childlike belief that the energy consumed in the resistance is "choked back" through the meter, and does not, therefore, appear on the consumer's bill for the quarter. Our remarks are chiefly intended to apply to direct current supply, and the regulators for use on such circuits; the question of alternating current arc lamps is one demanding separate treatment.

## WORLD'S FAIR ELECTRICAL PLANT.*

By R. H. PIERCE.

(*Concluded from page* 231.)

### INCANDESCENT PLANT.

All but a small portion of the incandescent lighting of the exposition is supplied from the Westinghouse plant. This plant comprises twelve 10,000-light dynamos, six of which are directly connected to 1,000 horse-power engines and six are belt driven, and two 4,000-light dynamos, also belt driven.

All these dynamos furnish a current of two 200 volts electromotive force, and are compound wound. Each 4,000-light machine has its own exciter, but the twelve 10,000-lighters have their fields excited by three 100 horse-power exciters which are operated in multiple arc. These machines are all connected to an immense switchboard, which is the most striking object in the electrical plant. This switchboard, which is of white marble, is arranged in two stories or sections. The lower, or dynamo board, controls all the dynamos. Each large alternator is a double machine, having two independent armatures, so that the board practically has connections for 26 alternators and five exciters. The three large exciters, which are compound wound for 250 volts, are connected to a three-bar bus system, which feeds the fields of all the large dynamos.

The second story of the board is the circuit board, carrying nstruments and switches for 40 circuits or feeders, and the whole system is so arranged that any dynamo can be connected to supply current to any of the 40 feeders.

The twelve large machines are wound for only 7,200 alternations per minute, thus supplying current which can be used with perfect success in supplying arc lights. Each large machine, as before stated, has two independent armatures. These armatures are so connected that the two circuits from each dynamo carry current differing in phase by 90°, so that any of the large machines may be used to furnish current for operating either incandescent or arc lamps, or two-phase motors.

The distribution of incandescent lighting is shown in the following table :—

EXPOSITION LIGHTING.

LIGHTING INSIDE OF BUILDINGS.

| | Lights. | |
|---|---|---|
| Adminstration | 2,949 | |
| Agriculture | 728 | |
| Music hall, casino, and peristyle | 4,122 | |
| Gallery fine arts and annexes | 17,774 | |
| Manufactures | 1,113 | |
| Machinery hall and annex | 1,772 | |
| Woman's | 3,272 | |
| Miscellaneous | 6,064 | |
| Total inside lights | | 37,794 |

EXTERIOR OR DECORATIVE LIGHTING.

| | | |
|---|---|---|
| Basin and bridges | 2,331 | |
| Cornice and dome of administration | 2,049 | |
| Other cornices | 3,786 | |
| Total decorative lights | | 8,166 |
| Grand total exposition lights | | 45,960 |

CONTRACT LIGHTING.

| | | |
|---|---|---|
| Buildings of States and Governments | 4,881 | |
| Buildings of concessionaires and exhibitors in Midway Plaisance | 5,416 | |
| Buildings of concessionaires and exhibitors in Jackson Park | 1,947 | |
| Exhibitors and concessionaires in Exposition Buildings | *7,468 | |
| Total contract lighting | | 19,712 |
| Grand total | | 65,672 |

The circuits or feeders are calculated for a loss not to exceed 10 per cent., each circuit being provided with a Stilwell regulator, capable of increasing or decreasing the initial pressure on a circuit 5 per cent. All circuits, excepting one, to the south grounds, are run entirely under ground. The cables, from the switchboard to converters, are all duplex Waring cables, except in the main subway, where Grimshaw rubber covered wire is run on insulators. All converters are placed in fire and water-proof pits just outside the buildings, and the secondary wires are led into the buildings in vitrified tile duct. The largest converter used has a capacity of 200 lights, and nearly all are of that size. Every converter on the ground has its own independent secondary circuit, so that no trouble upon a secondary or inside circuit could ever put out more than 200 lights. The secondary wiring is controlled in all cases by switches and cut-outs located at points where wires enter the buildings, and the circuits are, in general, distributed from asbestos lined boxes in which the cut-outs and switches are bunched at centres of distribution. The inside wiring is done entirely with the best grade of Grimshaw rubber covered and taped wire, and the wires are run almost entirely in standard moulding or in interior conduit. The lamps, which are of 105 volts, are all the new stopper lamp of the Westinghouse company. The general standard of the exposition lighting, for lamps suspended at the ordinary height from the floor, is 40 square feet of floor surface per 16 C.P. lamp, but, inasmuch as the plant presents almost every variety of an incandescent lighting problem that can be thought of, the intensity of lighting varies greatly, ranging from 18½ square feet per 16 C.P. lamp in the gallery of fine arts, and 7½ square feet per 16 C.P. lamp in the smallest gallery, to 3,700 square feet per 16 C.P. lamp for the system of patrol lighting under the floor of the manufactures building.

The most novel lighting is the lighting of the tanks in the fisheries building, the aquaria being lighted only by invisible lights shining through the water of the tank.

The most brilliant lighting is the lighting of the gallery of fine arts, where the lamps are placed in reflecting screens around all sides of each picture gallery, the lights being only eight inches from socket to socket for nearly two miles of screens.

The finest lighting is undoubtedly that of the administration building. The lighting of the interior is wonderfully uniform, and, in conjunction with the exterior decorative lighting, forms probably the most difficult and beautiful piece of incandescent lighting ever executed. In the incandescent lighting of the exposition it has been the aim throughout to avoid display lighting, but to secure sufficient and uniform illumination, and, where the lights have been placed for decorative effects, to place them so as to be inconspicuous by day, and to bring out at night the decoration or lines of the buildings. Wall sockets have been largely used, and stiff pendant fixtures have been used but in one building, simple clusters, hung from flexible cord, being almost universally used. This method of construction proves very satisfactory, and has the advantage of being easily and quickly installed, so as to always present a mechanical appearance. It is easily maintained, and, what is important in an exposition, the position of the lights can be easily and quickly changed without disfiguring or damaging the ceiling.

In addition to this lighting, the Siemens & Halske Company, of Berlin, has installed the following incandescent lights :—

Wooded Island, 120, 25 candle-power; Choral Hall, 1,740 lights, equivalent to 2,462 lamps of 16 candle-power; terminal station, 567 lamps, 16 candle-power, being equivalent in all to 3,117 lamps of 16 candle-power. This makes a total of all incandescent lamps of equivalent to 68,789 lamps of 16 candle-power.

The Siemens & Halske lights are operated from a generator in the German section, machinery hall, having a capacity of 700 kilowatts, and furnishing current to the light mains of 440 volts.

The lamps upon Wooded Island are operated in series of four, and incandescent lamps in the buildings are operated upon a five-wire system with equalising motors at the centres of distribution. The feeders are of armoured cable laid direct in the ground. This plant is interesting as illustrating the difference between European and American practices, and is the only plant of its kind in practical operation in this country.

* Read before the World's Congress of Architects, Chicago, August 2nd, 1893.

### POWER.

Although the electric lighting has been carried out on a scale never before approached in an exposition, it is in the transmission of power that the advance of the art of electricity is most conspicuously shown. With the exception of the power in machinery hall, and a portion of the power in the mines and mining building, all the power which is transmitted from the great power plant is transmitted by electricity, and even in machinery hall electricity operates the great cranes, the elevators, and a part of the main line shafting. Circuits are so arranged that power can be had in any building and in any portion of the grounds. The generating plant in machinery hall comprises the machines shown in the following table:

GENERATORS.

| Make. | No. of gen. | K. W. | Voltage. | Total K. W. |
|---|---|---|---|---|
| Exposition: Mather ... | 2 | 225 | 550 | 450 |
| Mather ... | 2 | 120 | 550 | 240 |
| "C. & C." ... | 4 | 80 | 550 | 320 |
| "C. & C." ... | 2 | 80 | 250 | 160 |
| Eddy ... ... | 4 | 186½ | 550 | 746 |
| Westinghouse | 1 | 373 | 550 | 373 |
| | | | | 2,289 kilowatts. |
| Exhibitors: National ... | 1 | 80 | 500 | 80 |
| Jenney ... | 1 | 40 | 500 | 40 |
| West'n Electric | 2 | 137½ | 250 | 275 |
| Wood ... ... | 1 | 120 | 500 | 120 |
| | | | | 515 kilowatts. |
| Grand total ... | | | | 2,804 kilowatts. |

Making a total generating capacity of 2,289 kilowatts, or 3,070 electrical horse-power for exposition use and 515 kilowatts, or 690 electrical horse-power for exhibitors' use—a grand total generating capacity of 2,804 kilowatts, or 3,585 electrical horse-power.

All the generators, except two 80-kilowatt machines, which supply the power for the elevators in administration building, are regular street railway generators, wound for 500 volts, with a guaranteed electromotive force of 550 volts at full load. Each type of machine has its own independent switchboard, but relay circuits are run between boards, so that, in case of emergency, the feeders from one board can be fed from the generators of another. The circuits are run in the main subway and upon the structure of the elevated railway. The feeders and mains consume 180,000 feet of No. 0000 wire, B. and S. gauge, 19,000 feet No. 000 B. & S. wire, 12,000 feet No. 0 B. & S. gauge, and 24,000 feet No. 1 B. and S. wire. This is exclusive of the distributing mains running to the various motors. All the wire is rubber covered and braided, the No. 1 wire having $\frac{3}{32}$nds of an inch thickness of rubber, and the larger sizes are covered with $\frac{1}{4}$th inch thickness of rubber. The cable is of the make known as the E. M. W.

The motors used by the Exposition Company are all supplied by the General Electric Company, with the exception of two 150 horse-power Westinghouse motors operating shafting in the mines and mining building. Exhibitors provide their own motors of such type as they wish. The applications of electric power are almost universal, as electric motors are used to operate almost every kind of machine in use by the exposition, or displayed by exhibitors.

The distribution of light and power as shown in the tables is exclusive of the electric power consumed in the electricity building. This building consumes all the electricity generated by the machines designated as exhibit machines, the electricity being used for light, heat, and power, and for producing the many electrical effects displayed in the electricity building.

### ELECTRIC LAUNCHES AND ELECTRIC FOUNTAINS.

The four 150-kilowatt Edison dynamos furnish current for operating the electric fountains in the evening, and for charging the storage batteries of the electric launches after 10 o'clock at night.

Each fountain is illuminated with 19 80-ampere Knowles arc lamps, requiring in all 300 kilowatts or 400 electrical horse-power.

The launches, 58 in all, are each equipped with a motor of 4 horse-power, operated by a storage battery of 78 cells.

The circuits of both fountains and launches are of Edison underground tubing, and are arranged as a three-wire system.

### INTRAMURAL RAILWAY.

Although it is not a part of the plant in machinery hall, a description of the electric plant would not be complete without a reference to the electric intramural railway. This road is the finest elevated electric railway ever constructed. The station has a generating capacity of 3,700 kilowatts, or 5,000 electrical horse-power, including the largest railway generator in the world, rated at 1,500 kilowatts, or 2,000 electrical horse-power. The road has 6¼ miles of single track, and is installed with a third rail system. The cars are regularly run in trains of four, each having a capacity of 133 horse-power, with a speed of 25 miles an hour.

### INSTALLATION RULES AND INSPECTION.

The installation of the electrical plant throughout has been carried out according to the rules known as the national code, which was accepted as the standard by the insurance auxiliary committee. This code has been made part and parcel of all specifications and contracts. More than ordinary care has been exercised in inspection. Each large building has had a special inspector, as well as each principal branch of the work. Working plans were made showing the location of every lamp, either arc or incandescent, except where lights were located in exhibitors' spaces or pavilions of which detailed plans could not be obtained, and, in these cases, the plans show circuits up to the cut-outs in exhibitors' spaces. The contractors for incandescent lighting were required to submit for approval, in all cases, working plans showing details of cut-out boxes, and arrangement of circuits, showing each light, and having marked in figures the length of each circuit and the gauge of the wire. Four prints were made of each plan, the contractor and exposition each keeping one print as a record, the third print being given to the foreman of the contractor as a working plan, and the fourth being given to the exposition company's inspector, whose duty it was to see that the work was installed according to the plan and national code, and in a workmanlike manner. Although the making of complete wiring plans has apparently never been considered necessary by architects, it was found to be the only way in which a work of this magnitude and variety could be thoroughly inspected, and the results obtained were most satisfactory. The inside wiring almost always tested out perfectly clear, with very high insulation, and when the lights were thrown out by thousands for the first time, the inside wiring was almost absolutely free from "bugs," and if there were any, they were so easily removed, that their presence was never noticed.

Much that would be of interest cannot yet be written, for the efficiency of the various machines is yet to be determined by tests, and the length of this paper does not admit of going into details of construction; but I will conclude by enumerating a few points to which I would especially direct the attention of such as may wish to draw conclusions from the inspection of the electric plant.

1. The great saving of space to be made by the use of the direct-coupled dynamo.

2. The advantage of the adoption of a central station system having machines of one type and large units suitable for supplying both arc and incandescent lights and power service from the same conductors.

3. The advantages in series arc wiring of construction and devices which do away with slack wire and admit of more mechanical construction, and a neater appearance than is generally obtained in this class of work.

4. The possibility of, in all cases, doing mechanical work, and at the same time having all conductors accessible.

5. Advantages to be gained by the use of iron pipes as an interior conduit, not only as a matter of safety, but economy.

6. The advantages of an inspection of electrical work, not merely by making electrical measurement after the work is completed, but by having practical men see that the work is mechanically perfect as the work is being done.

7. The great advantage of having complete detailed work-

ing plans of wiring construction, in order to be sure that the work is properly laid out, and is installed as it is laid out; and in order that the work may be at any time easily maintained and readily changed or repaired by any intelligent workman.

## A MECHANICAL EFFECT OF VERY RAPID ELECTRIC OSCILLATIONS.

By Dr. L. BLEEKRODE.

WHILST engaged in some experiments with alternating currents produced by a high tension apparatus that was arranged after the indications of Mr. Tesla and Prof. Elihu Thomson, I noted an effect on thin wires, which, though observed more than a half century ago, and then obtained by a discharge of statical electricity, may prove of interest to be recalled to the attention of electricians, when effectuated by more modern apparatus, and the results most accurately represented. A sketch of the experiment is given in fig. 1.

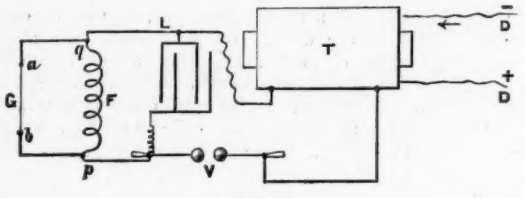



FIG. 1.

I used a dynamo driven by water power to operate a Ruhmkorff coil, T, as first transformer of the direct current coming from D, and this was provided with a modified Deprez interruptor, making extremely rapid oscillations, and to avoid the noxious effect of the spark that appears as the circuit is opened, I included eight 16-candle-power incandescent lamps, with much success, as the coil worked with great regularity. I limited the inducing current to 30 volts and 4 ampères, nearly sufficient to obtain 9-inch sparks. The coil charged the condenser or Leyden jar, L, of 10 litres size, acting as a second transformer, and it was discharged in V at variable distances. A thick iron wire ($\frac{1}{4}$ inch diameter) was wound to a spiral, F, of 12 turns, and included in the circuit and to its ends, in $p$ and $q$; a very thin platinum wire of 0·07 millimetre diameter was joined as a shunt, shown at G, and nearly $1\frac{1}{2}$ decimetre in length. When the apparatus is set working, a discharge, as is well known, occurs in V, when the gap is regulated, and at the same time an extremely rapid oscillating current is excited by self-induction that flows through the thin wire, $a$ $b$. We may then observe:

1. When the joints in $a$ and $b$, and also in $p$ and $q$, are somewhat imperfect, or loose, brush discharges are visible in these points every time; that sparks are obtained in V.

2. The thin platinum wire, G, vibrates over its whole length very distinctly, and this is the more visible when, by adjusting rightly the spark gap and using sufficient electromotive force, the wire is heated to dull red or higher; but often, after continuing the experiment during some seconds, it is broken at $a$ or $b$.

3. The wire appears to be strongly shaken by a mechanical effect of the oscillations due to the current which it conducts, and they produce the inflections that are observed on the surface of the wire, and which deserve attention for their peculiar character and size. These are represented in fig. 2 fairly well; the figures having been reproduced by the wires themselves, as they were laid down, after the experiment was finished, on a bromo-gelatine glass plate, and thus direct photo impressions were obtained. There is considerable difficulty, however, in reproducing by process block the exact conformation of the wires as shown on the photographic plates.

Only with three of them (2, 3, 4), the change on the surface of the wire may be readily perceived by the unassisted eye; the others are better examined with a common magnifying glass. 1. sustained two discharges only, and shows one or two inflections. 2. was exposed during half-a-dozen spark discharges; 3. and 4. sustained numerous rapidly succeeding discharges, and it is easily observed, that the number of

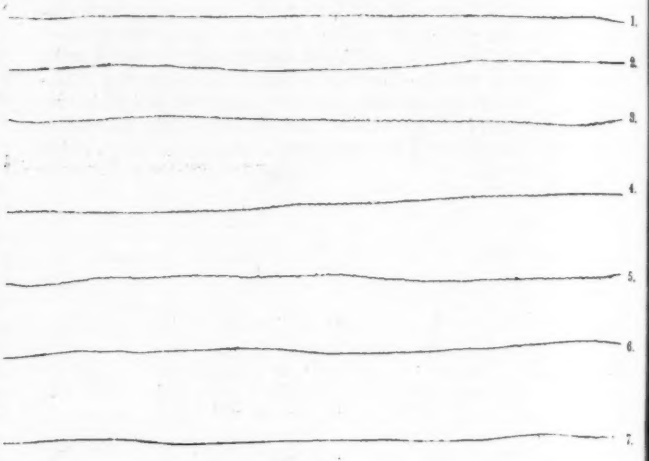



FIG. 2.

inflections increases, that there is some regularity in the effect produced, and especially that the deformations have a peculiar character, as if they were made with an edge-shaped instrument. In 5., the discharges followed at an exceedingly rapid rate through a small spark gap. Here the effect is the best perceived when magnified, and then numerous small inflections will be observed, which on the wire itself are easily seen by the reflection of light at its surface. 6. was obtained when using, instead of the coil and dynamo, a Wimshurst static electrical machine, and presents large undulations, and 7., where the undulating impressions are still clearly visible, stretched at one end, was during the experiment, by a weight of 20 grammes. Ordinarily, when the wire had to sustain the effect of the oscillating discharge, during some time, it was broken at the extremities, in consequence of the vibrations in these points being very strong. It is well known, from the experiments of Dr. D'Arsonval and Mr. Swinburne, that an incandescent lamp may be put at the place of the thin wire in G, but I saw it always rapidly deteriorated, by numerous carbon particles being pulled away in straight lines at the points where the carbon filaments joined the platinum electrodes, till it was broken there. Mr. Tesla, in his previous experiments (ELECTRICAL REVIEW, 1891, p. 108), mentions the spinning motions of wires enclosed in glass globes when used as an electrode, but this seems to have another cause than which is coming into play here, and the facts I give here are a confirmation of the experiments related by Becquerel as early as in 1837. He used an electro-static machine and Leyden jar, to get a discharge through very thin wires, and thought these were increasing in diameter, and shortening in length by this effect; he gives only one inaccurate representation of the condition of the wire. Riess, in 1845, published extensive and more exact observations on this subject, but gives no engravings in his paper, though his description is very complete, and he even tells that in several cases he had the angle of the inflections measured, amounting to nearly 110°. He also corrected the opinion that was prevalent in those times, that an electro-static discharge could shorten the wires which conducted it, as the numerous inflections, almost at right angles to its length, may sufficiently account for this, as, for instance, is very possible from 2. of fig. 2. With wires of nearly 0·25 mm. diameter, the deformations, at least, in my experiments, were not sharply indicated, and I must add, finally, that it appears to me rather difficult to reconcile with the described facts that points to a powerful attack of the high-tension alternating current on its conductor, the theory that it is travelling in a skin-deep layer only at the surface, which amounts, according to recent investigations of Prof. J. Thomson, to only 0·005 mm. in depth.

## ELECTRICAL ENGINEERING AT THE WORLD'S FAIR.

[FROM OUR SPECIAL COMMISSIONER.]

X.

AMONG notable steam engines at this exhibition used for electric lighting, Dr. de Laval's steam turbine is perhaps the most novel engine shown. The Parsons steam turbo-electric generator is given a place in the catalogue, but the space allotted to it is empty. Laval's steam turbine runs remarkably noiselessly, and is an extremely simple engine. There is only one turbine wheel in it, a parallel flow-partial turbine wheel, like the Girrard water-wheel. There are some novel features in it. The wheel is mounted on a steel spindle, one end of which is made so thin, that it may be looked upon as a flexible shaft; this flexible shaft is stiff enough to act as a guiding shaft, and yet yields to any movement of the wheel eccentrically, so that no vibrations are set up in the engine bearings.

The nozzles, or steam jets, which deliver the steam upon the wheel, are of a pecular shape, which shape the inventor claims to secure the advantages of expansion.

Just before the steam enters the turbine wheel buckets, *b*, *b*, in fig. 1, the nozzle expands from a throat, *a*. The steam

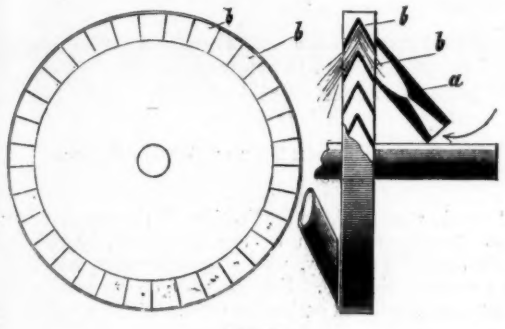



FIG. 1.

is said to be superheated in passing through the contraction, *a*, and it is claimed that economy results in this expansion of the steam in the nozzles after passing the throat.

In the actual engine there are eight nozzles delivering steam on one wheel, four nozzles on each side, so that the wheel is balanced between them. The running of these wheels seemed to be perfect, whatever their economy might be; they run almost noiseless, and without any vibration whatever. The turbine, shown in fig. 2, is all contained in

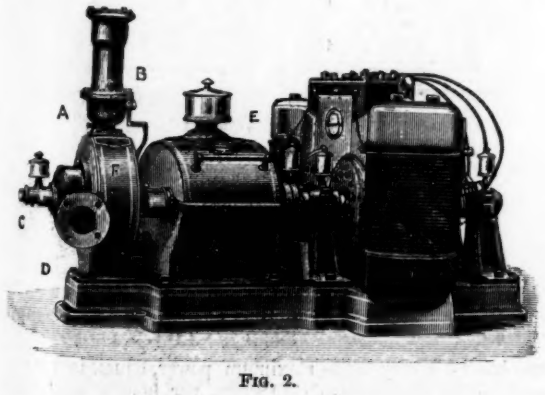



FIG. 2.

the small case, F. B is the governor valve box; C the bearing carrying end of flexible shaft; D, exhaust pipe; E is a case containing gearing to reduce the speed 10 to 1; it drives a double armature dynamo, thus balancing the gearing. This gearing runs very smoothly, and perfectly silent, and is one of the cleverest parts of the combination; it is a fine-cut steel skew-wheel gear.

The turbine runs at 20,000 per minute, while the dynamos run at 2,000.

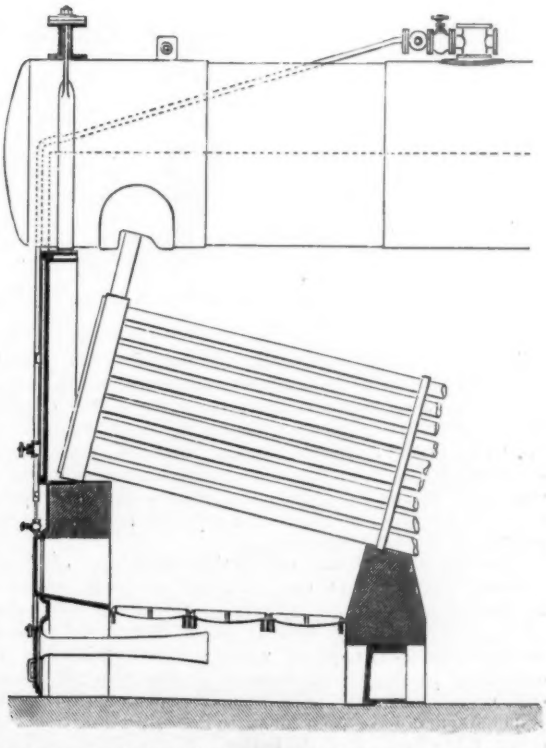
The two dynamos are coupled to run either in parallel, to run on a two-wire distribution, or in series, to run on a three-wire system.

The whole arrangement is very compact, and would form an excellent generating plant for ship lighting. As to the economy, that cannot be ascertained; the high speed (20,000) tends to economy in steam turbines such as this. The expansion of the steam in the nozzles, and its superheating in passing the throat of the nozzle, may also contribute to economy, but that is not quite apparent.

The 20 H.P. turbine has a disc wheel about 8 inches in diameter, so that the speed of the turbine buckets is 40,000 feet per minute, hence we can calculate the effective pressure of the steam when 20 H.P. is given as equal to $\frac{20 \times 33{,}000}{40{,}000} = 16{\cdot}5$ lbs., neglecting friction, and $\frac{16{\cdot}5}{8}$ equals a little over 2 lbs. per nozzle; it will be seen from this rough calculation that if the boiler pressure is, say, 100 lbs. per square inch, that the sectional area of the throat of the nozzles may be a very little over $\frac{1}{50}$th of a square inch, whatever may be the area of the turbine blades. The expansion of the nozzles allows larger blades to be used, and a less difference of pressure between the inlet side and outlet side of the buckets; hence the velocity of efflux of the steam can be brought down to a very low value, and economy in steam in turbines depends largely upon the relative velocities of the blades and the steam. In older steam turbines the steam at high pressure was allowed to flow directly into the turbine buckets, so that the velocity of the steam was enormously greater than the velocity of the blades; hence their want of economy.

## MELDRUM'S IMPROVED FURNACE.

A NEW apparatus has been designed by Messrs. Meldrum Bros. to assist the natural force of draught in boiler furnaces as ordinarily obtained by means of a chimney shaft.

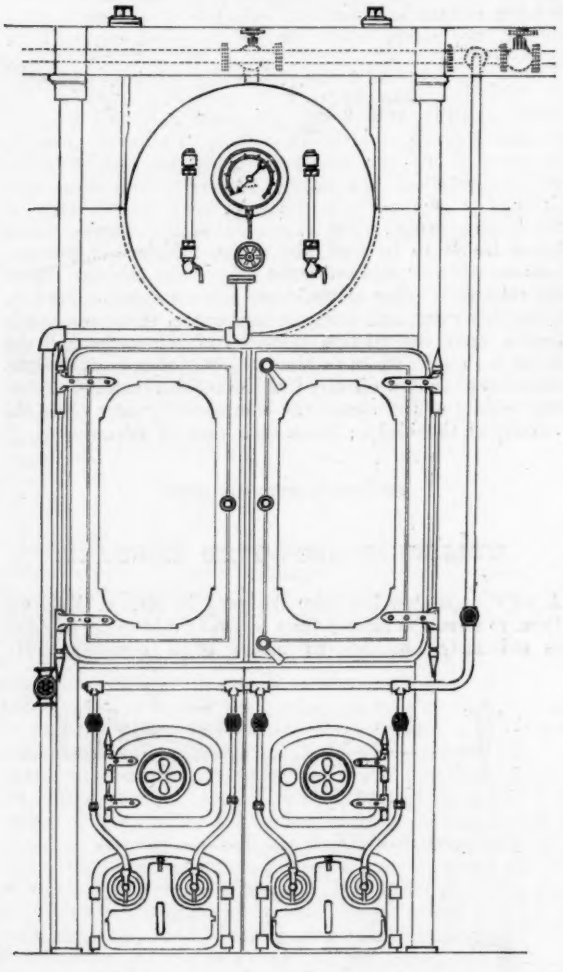


SECTION OF BABCOCK FITTED WITH MELDRUM'S FURNACE.

Draught obtained solely by the latter means is always subject to variations of its force, and anyone who has tested the draught of a chimney shaft under various conditions of the

atmosphere, will be aware that this variation is large and important, depending on dryness or humidity, and the force and direction of the wind; the force of draught in the same chimney, in some cases, will be double under the most favourable circumstances what it is under the least favourable.

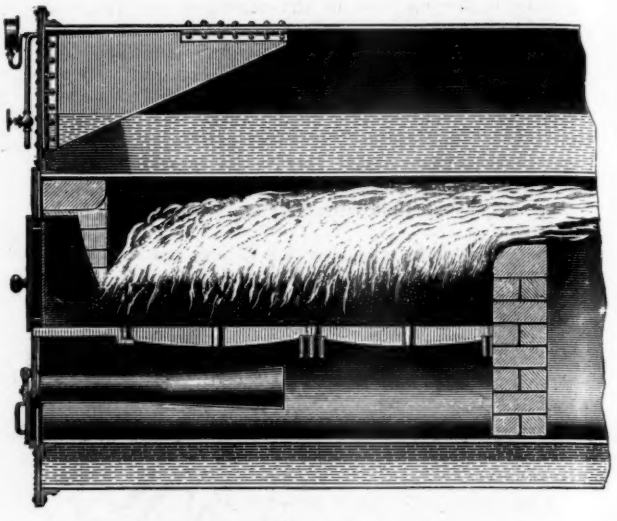
Evidently it is desirable to be able to rely upon commanding a certain force of draught, and an apparatus which will conveniently and economically ensure at any desired moment the maximum power of the chimney, and if need be, more than that power, has a wide field of application.



BABCOCK FITTED WITH MELDRUM'S FURNACE.

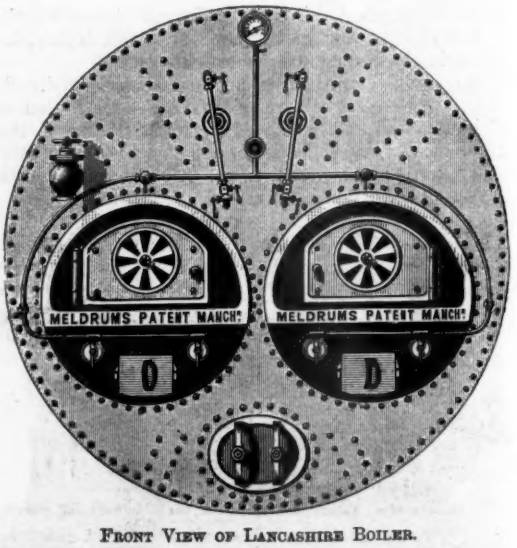
Forced draught as obtained by the use of a fan presents the objection that if the fan be driven from shafting in connection with the main engines, the force of the draught cannot be regulated with any degree of nicety, while if the fan be driven by a special engine, so that the speed can be regulated as desired, a disproportionate amount of steam is consumed in driving the engine, besides the other petty expenses involved in running a separate machine, to say nothing of the space occupied.

The steam-jet blower offers the advantage of being instantly regulated, as it can be stopped altogether or set to its greatest power by simply turning the steam inlet valve, while it has no moving working parts. Steam jets have in many instances been applied which were not satisfactory, on account of passing too much steam in proportion to the work done on the air; many have been designed on entirely wrong principles, and have been found to decrease rather than increase the efficiency of the boiler. Messrs. Meldrum claim that after some thousands of experiments they have produced a steam-jet blower which injects more air per pound of steam used, than can be effected even with a fan driven from shafting; the result of three years' working shows that, at all events, their system is found of great service, since over 1,200 boiler furnaces are now fitted with it. As shown in the illustration, they usually apply two blowers to each furnace of a Lancashire boiler, or four to that of a Babcock and Wilcox boiler. The front of the ashpit is closed, and the blowers will maintain a pressure under the grate, so as to force air through a thick fire of small and dusty fuel when necessary.



SECTION THROUGH FLUE OF CORNISH BOILER.

A good example of the application of the system is at the West Brompton Station of the House-to-House Electric Light Supply Company, where the apparatus has been in use for nearly 2½ years. Four Babcock boilers and one Lancashire are fitted, and anthracite coal is used, the blast in this




FRONT VIEW OF LANCASHIRE BOILER.

case having a very large maximum power, equal, in case of need, to the consumption of 18 cwt. per hour of anthracite coal, on the 32 square feet of grate surface of each Babcock boiler; while the apparatus can equally well be operated (as it constantly is) to simply keep up sufficient combustion for maintaining steam in the stand-by boiler; in case of need the fire can at once be blown up to full power.

The presence of the small amount of steam in the air preserves the fire-bars for a great length of time; the spaces between the bars are about $\frac{1}{16}$th inch wide, so that small stuff will not drop between.

Anthracite coal is in many instances burnt by means of

this apparatus, and many boilers in London and elsewhere are burning coke breeze with good and economical results.

The City of London Electric Light Company have some boilers fitted with the apparatus, and Messrs. Willans and Robinson employ it on three boilers at their works.

The introduction of this apparatus has given an impetus to the use of mechanically produced, as against natural draught, by dispensing with the objectionable features of fans and moving machinery, and with the waste of steam associated with the use of previous forms of steam-jet blowers.

It will be observed from the illustrations that the apparatus does not project into, or occupy any extra space, in the boiler house.

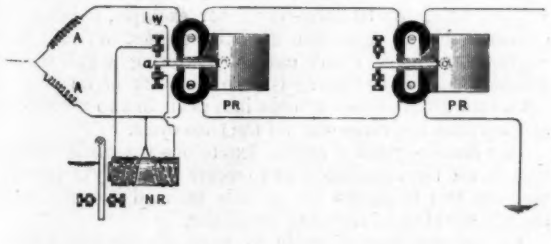
Messrs. Meldrum have handed us a pamphlet which they have had printed, detailing the numerous firms and establishments that have been supplied with their patent furnace. There is a lengthy list of chemical works, baths and wash-houses, paper mills, breweries, collieries, electric light works, engineers' factories, gas works, &c.

## THE MOMENT OF REVERSAL IN THE QUADRUPLEX NEUTRAL RELAY—THE WICKS ARRANGEMENT.

AN arrangement for use on the neutral side of the quadruplex has been brought out by Mr. P. J. Wicks, of New York City, which arrangement avoids the moment of reversal in the neutral relay, and introduces, instead, a brief instant of diminished current only in the relay.

It is well known that the self-induction of a relay will retain the armature for a brief interval after the original current has been withdrawn. On the other hand, it is next to impossible to make a moment of reversal of magnetism so brief but that the armature will be withdrawn by its retractile spring. The former fact is taken advantage of in the Wicks device to insure a practically continuous current through the neutral relay at the time of reversal of the distant battery.

The Wicks arrangement is shown by the figure. P R is the differentially wound polarised relay ordinarily employed. P $R^1$ is an extra polarised relay, also differentially wound.




A A are resistances forming the arms of a Wheatstone bridge. N R is a two-coil neutral relay. One terminal of each coil is connected to one arm of the bridge; the two remaining terminals are joined and connected to a contact point at the armature, *a*, of P $R^1$. A wire, W, connects the armature, *a*, to the other arm of the bridge. Hence, normally, one or the other coil of the neutral relay, N R, is in the bridge wire.

If the armature of the extra polarised relay were stationary, only one coil of N R would be in circuit, and the reversals of current direction flowing through that coil, due to the reversals of the distant battery, would be felt as in the ordinary neutral relay. But as the armature, *a*, oscillates from side to side, in response to the distant reversals, it follows that the current in the bridge wire flows in each coil alternately, and although the direction of the current as a whole in the bridge wire is, of course, reversed in accordance with the reversals of the distant battery, still, owing to the manner in which the coils of the neutral relay are arranged, the current passing around the core of that relay is always in the same direction and thus it ensues that no reversals of magnetism take place in its core, and the momentary break of the circuit at the moment when the armature of P $R^1$ is passing from one contact point to the other is not materially felt.

The experiments thus far made with this arrangement indicate that it will prove a successful working device.

We may mention that the Wicks arrangement is not actually a novelty in this country, as, although it was not published, it was suggested and tried experimentally in the General Post Office some years ago.

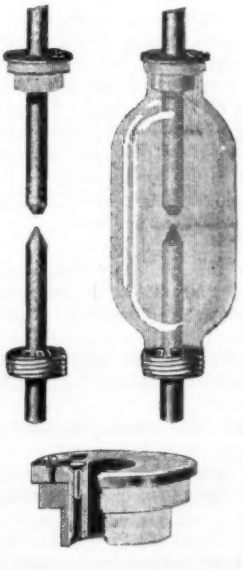
## AN IMPROVED ARC LIGHT.

No improvements in the arc have been made during the past 10 or 12 years, although hundreds of patents have been applied for and granted for improvements in arc lamps; these improvements in every case relate only to some improved piece of mechanism in the regulator, or to some kind of carbon rod. Not long since a great improvement was claimed for the use of carbons soaked with paraffin oil, or with a wick to carry up oil to the arc.

We have three forms of electric light. The incandescent lamp, the semi-incandescent lamp, and the arc lamp. Incandescent lamps are of two kinds, the carbon filament in a vacuum, and the incandescent lamps like the sun lamp, in which a marble block glows in the open.

A new improvement has just been brought before the Congress of Electricians at the World's Fair, Chicago. This improvement is one upon the arc itself, and consists in forming the arc in a hot atmosphere of its own products, and whereby the atmospheric oxygen is excluded, and the rate of consumption of the carbon is very much lessened.

A lamp working in this way has been tested and gives remarkably good results; it has been called an "incandescent arc lamp," a name which is somewhat ambiguous, and, moreover, there is nothing more incandescent about it than there is about an ordinary arc; it is simply an arc, surrounded by the hot products of its own formation, and by a hot envelope of glass. Fig. shows the arc enclosed in a glass bulb, which is made of highly refractory glass. The envelope is closed at the bottom, and provided on top with a metal plug having an opening in it just large enough to admit of the feed of the upper electrode. A fireproof plug of asbestos



pulp insulates the metal from the glass. A valve shown in the plate allows the egress of gas, but prevents ingress of the air. With this construction the operation of the lamp will be as follows :—

Upon the closure of the circuit, and the springing of the arc, the air in the enclosing envelope is robbed of its oxygen, the latter uniting with the carbon of the electrodes to form CO and $CO_2$ gases.

The gases are brought to an exceedingly high temperature, at which they maintain the carbon vapour issuing from the arc. This vapour is deposited in the form of a thin coating on the internal surface of the glass chamber.

The expansive force of the gases may become sufficiently great, if no means of egress be provided, to rupture the envelope; hence a small safety valve is provided for their outflow. The only possibility of ingress of air is through the narrow space between the positive carbon and the plug; experience has shown that after the temperature has been raised beyond a certain point, the amount of air that enters in this way is inappreciable; in any event, the oxygen is immediately converted by combination.

It is important that the enclosing glass envelope be as small as possible for the conservation of the radiant energy, and, hence, the efficiency will depend largely upon the size of the chamber. The heat, which in the ordinary arc light is dissipated in the air, is here conserved, and raises the temperature of the enclosed gases and vapour of carbon. The proper conditions being fulfilled, the lamp maintains its maximum efficiency shortly after the current has been passed through it, and glows like the incandescent with the brilliancy of the arc light. The arc proper is scarcely visible, but the entire contents of the chamber seem to be luminous, giving the appearance of a solid cylinder of light.

The pressure, as well as the temperature of the enclosed gases, has a very important bearing on the performance of the lamp, and affects to a marked degree the character of the carbon deposit on the glass chamber.

The structure and constituency of the electrode are also pre-eminently important. Absolute purity of the carbons is imperative.

The experimental burning of an arc in a closed glass vessel has often been tried, with the result that the sides of the glass were rapidly obscured by deposited carbon. The globes or vessels hitherto employed have apparently been too large. They remained cool, and hence condensed the carbon and other products on their inner surface; it seems now that, with a globe small enough to become highly heated, the obscuration of the light does not happen.

The heating cannot be very great, so long as glass globes are used in this way.

Some measurements have been made which go to prove that the efficiency of the arc light from a closed globe is fairly high, being only a little less than the open arc. While the light is not so intense it appears brighter, and the whole globe seems filled with a solid glow. The tests come out at 1·17 watts per candle-power; 637 candles per horse-power as the mean illumination below the horizontal line. The carbons consumed in a lamp taking 55 volts and 10 ampères during 100 hours' run was only 6·81 inches; the positive carbon burning at the rate of 1 inch in 14·67 hours, the negative at the rate of 1 inch in 145·45 hours—a most remarkable result.

There is no flaming and no hissing in the arc, and when used with alternating currents, the humming is subdued to a great extent.

The lamp requires the ordinary feeding regulator to maintain a steady length of arc.

We expect to hear more of this apparatus shortly, and anticipate a great future for it if no drawbacks develop when put into practice.

## CORRESPONDENCE.

### Ampère's "Swimmer" Rules.

In a leader last week you draw attention to certain correspondence in *Nature* (July 27th and August 17th) with reference to Ampère's "swimmer" rules. In one letter Prof. Daniell gives what he suggests is an improvement on Prof. Jamieson's (?) right-hand rule and the corkscrew rule. He complains that the latter wants thinking out. Surely it is quite as simple as the rule he gives (which you quote in your leader). Or take the screw rule (due to Maxwell, I believe), in which the rotation and travel of a right-handed screw are associated respectively with the + direction round the field (*i.e.*, the way the N. pole of needle will turn) and the direction of the current. What could be simpler than this? I have put a note of interrogation after Prof. Jamieson's name above, for it seems doubtful who really did originate the hand rules. Some are credited to Prof. Fleming. Another correspondent in *Nature* (August 17th) cites a rule which he says was given by a Prof. Holten 20 years ago, but which is virtually the same as that Prof. Jamieson gives as his on p. 83 of his "Magnetism and Electricity."

Some two or three years ago a student of mine originated, and I put into shape, a fundamental hand rule connecting the direction of the current and its field; and in this rule it was only possible to place the hand so that the thumb denoted the direction of the current and the fingers the + direction round the field. In Jamieson's rules the thumb denotes the direction of the field, while in Fleming's rule the thumb denotes the direction of motion of a conductor across the field. I have modified these various hand rules, so that they should agree with the fundamental rule mentioned above as regards the placing of the hand. These modified rules are given and illustrated at pp. 43, 45, 46, 65 and 248 of my "Electric Lighting and Power Distribution:" they were also fully described and illustrated in an article by me in your issue of January 15th, 1892, in which I remember comparing Ampère's and various other rules. Whoever may lay claim to the origination of the hand or screw rules does not much matter, perhaps, but it is very certain that they are far more adaptable than those of Ampère, which should by now be regarded as relics of the past.

**W. Perren Maycock, M.I.E.E.**

## MODERN GAS AND OIL ENGINES.

SIXTH PAPER.

MR. SPIES claims that there is now no field in which the gas engine has not successfully operated or given promise to do so; that it is now no longer the noisy machine it once was, nor is it so extraordinarily bulky for the power it will develop. As an engine specially applicable for launch purposes, he now illustrates and fully describes the Daimler motor, which is built both in America and in England of various sizes, the 10 horse-power for example, having four cylinders side by side—four 2½ H.P. engines, in fact. This engine has a closed crank casing containing a pair of disc cranks which act as fly-wheels. In the back of one disc is cut a cam groove which returns into itself in two revolutions and operates the valve gear on the Otto cycle.

In a double-cylinder engine explosions are made to alternate in the two cylinders so as to secure regularity of turning, and the two cylinders are a little inclined to each other though working on the same crank pin.

The exhaust pipe is made to warm the air that is being drawn to the carbonator when gasoline is the fuel used. Gas is admitted by an inward-opening valve and exhaust is by a valve which is kept shut, unless opened by the cam gear, which operates the exhaust by the action of the governor. Hence the exhausted gases are only allowed to escape when the engine falls below normal speed, and the escape of the exhaust allows a fresh explosive charge to be drawn in. At Stuttgart this engine has been used to propel a street car, and it has also been used to drive an inspection car on the railroads, to drive road carriages and cycles—even bicycles.

The ingenious engine of Atkinson, known as the differential, is awarded considerable praise; the peculiar motion given to the two pistons and the expansion to exhaust pressure in the time of only a quarter revolution of the crank shaft in only a quarter of the time necessary for such expansion in an ordinarily connected engine being allowed to be conclusively proved as tending to economy, in support of which is cited Prof. Witz. Witz found, experimentally, that by exploding

a mixture in a cylinder with a piston velocity of 1·7 metres per second, he obtained a certain power. By increasing the piston velocity, 2·54 times the amount of work secured was increased 2·9 times from the same charge, showing that the rapidity of cooling, due to the rapid expansion of the working fluid, prevented the passage of heat to the cylinder walls. It is tolerably certain that as long as the extremely unscientific water jacket is compulsory upon the cylinder of the gas engine, so long will economy follow abnormally high piston speeds. Atkinson has always endeavoured to follow out this theory, though it is possible that too much may be spent on mechanism to secure economy. The ordinary power user cannot, as a rule, see his way to pay more for one gas engine than another. A gas engine to him is a gas engine, and there ends his interest. Anything which will turn round will serve to drive his shop.

In the "Utilite" engine of Atkinson, an attempt is made to secure more or less definite layers of air and gas in the cylinder, and the crank case is closed and used as an air chamber for scouring purposes. Then some gas and air is admitted, and after this the piston pushes out some more of the exhaust, and after this again some air is let out before explosion occurs or compression is complete. We fear this sort of work must be responsible for explosions in the exhaust pipe.

There is nothing specially striking about the Hartz vertical engine which is said to be very suitable for dynamo driving, perhaps, because, though working in the Otto cycle, it is arranged so that there may be explosions of less than full strength, whereby the range of speed variation may be kept less than when explosions must be full or absent. The Weatherhogg engine made by Penney & Co., of Lincoln, England, has a six-stroke cycle, there being a full scavenging stroke. This is a petroleum engine, injection of oil to the vaporiser being controlled by a hit and miss device. Of the use of a scavenging stroke, now less common than formerly, it can at least be said that it is favourable to a method of working which shall avoid explosions without the working cylinder.

## NOTES.

**Expert Testimony.**—There is, perhaps, no class of expert testimony which demands more condemnation, with the exception of that which is given with the deliberate intention of deceiving, than that of the expert whose ability is not questioned, but who makes a report without, probably, giving a thought to the resulting consequences of the same. We have recently received a pamphlet (with reference to a matter which figured largely in the law courts a few months ago), the contents of which we think call for serious notice. We refer to a report given by Mr. H. E. Harrison, of the Electrical Standardising, Testing, and Training Institution, Faraday House. On the face of it, we do not doubt that the experiments and report are perfectly genuine and unbiassed, and are simply statements of results obtained, but then the question arises—are the experiments of any value, seeing that the expert must have known in what manner the appliances were intended to be used? To this, we would say, that a very little examination would show that the bulk of what is given as (presumably) useful scientific facts, is perfectly useless for indicating the value or worthlessness of the appliances in question. If the latter are made to act in a particular way, it is perfectly absurd to test them under conditions which do not occur in practice, and for which the appliances were not designed. It is a well known fact (not to Mr. Harrison apparently, however), that the skin resistance varies in a most marked manner with the voltage of the current passing; what use, therefore, is it to test the resistance with a voltage many times in excess of that which the appliances can give? A voltage of about ·75 is what the latter furnish; Mr. Harrison uses from 7·3 to 15·6 volts, thereby obtaining resistances far below what exist under the true working conditions. So much for the value of the principal experiments; we now come to another point. The report very definitely states what is a most damning statement, viz., that the "wearing of the belts produced sores"; finally, we have experimental evidence given of the minuteness of the currents which can be generated. So far, then, as the report goes, the major portion is of no value, and the remainder is condemnatory: Why then, it may be asked, can objection be taken to the same: the mere fact of a report, occupying several pages, being given by an expert of eminence, is quite sufficient to delude the public, whose reasoning powers on scientific matters are of the shallowest, and who look more to the position of the expert than to the contents of his report, and who argue (in this case with a show of reason) that no vendor would cry "stinking fish." Again, what would the public think if they found that the expert in question had allowed his name to become connected (no matter if it were intentional or not) with an appliance, the value of which was so recently exposed in the courts of law. The answer, we think, is obvious, and we have the double harm done of the sale of a questionable (to say the least) appliance being helped forward, and of a sound Institution being imperilled.

**Vegetation and Electric Illumination.**—We have to record a new observation by Prof. R. Chodat relating to the action of electric light on vegetation. In the *Archiv. Sci. Phys. et Nat.*, xxviii. (1893), pp. 478—81, he describes an investigation in which he demonstrated that electric illumination exercises a favourable influence on the germination of seeds. He confirms the statements of Mons. G. Bonnier (*Comptes Rendus*, cxv. (1892), pp. 447—50, 475—8), that the effect of this kind of light on herbaceous plants promotes the lengthening of the leaves and stems. Under glass, the light greatly accelerates growth and causes the green parts of the plants to assume a more intensely green tint. The structure is at first strongly differentiated, but prolonged exposure acts deleteriously in this direction. It would appear that too much electric illumination exercises a baneful effect, just like too much of anything. Without digressing in search of similes, we may find plenty in the culture of plants; thus liquid manure and chemical stimulants are useful in moderation, but become harmful to the growth of the plants when employed in excess. Too much electric illumination has a similar effect upon vegetation to that of darkness! It tends to retard healthy development. Hence it appears that if electricity is to find any useful application, say, in forcing plants for the early markets, it must be used cautiously. The plants must not be simply "drenched" with light, any more than they should be drenched with water continually; but, used under intelligent guidance and in moderation, the effect of the highly stimulating rays of the electric light will probably prove distinctly advantageous.

**Recent Researches by Nernst.**—Few modern experimentalists have achieved distinction so rapidly as W. Nernst, whose brilliant papers on physical chemistry, noticed from time to time in the ELECTRICAL REVIEW, have already become classics. Few, too, are so prolific in result; it is rare that any issue of the *Zeitschrift für Physikalische Chemie* appears without containing a paper by this scientist of too great importance to be overlooked. He usually attacks the phenomena which are met with "on the borderland" between physics and chemistry from the usually neglected aspect of mathematics, and it is not too much to say that no one is at present accomplishing sounder work, and pushing our knowledge forward in this direction with more progress. Amongst other papers, it is impossible to overlook his conclusions from a study of the migrating velocities of the ions. He has, finally, arrived at a law of distribution which is as follows:—At a given temperature each sort of molecule has a constant ratio of distribution between solvent and vapour, or between two solvents, independent of the presence of other sorts of molecules, and whether reacting chemically with them or not. (Different "sorts of molecules" are not only those of different substances, but also double molecules, single molecules, and different ions.) The notion of solution pressure, which is at the basis of Nernst's electrolytic theories, is usefully employed in explaining, for example, how it is that one metal drives another out of solution. In order to do so, it must always possess a superior solution pressure. For the most part, the electrolytic solution pressures of the metals are very great, and almost defy accurate quantitative investigation; it rapidly increases with the concentration of the acid solution, and is strongly depressed by the presence of neutral salt.

**Luminous Quantity and Intensity.**—A friend writes to us as follows:—"The question at the end of the last paragraph, p. 241 of last Friday's issue of the REVIEW, might possibly help a popular error, as it may cause a confusion in the mind between luminous quantity or potential and luminous quantity. I do not suppose that two miner's dips, placed, say, 6 inches apart (I place them 6 inches apart to prevent optical deception creeping in) could be seen any further off than one miner's dip, although the two give *more* light. Perhaps a few remarks on light intensity and light quantity might enable people to distinguish between the two, and clear up some foggy notions now afloat in talking about an arc light being equal to so many dips joined up in parallel instead of series. I do not want to hark back on the old controversy between Wigham's gas and the electric arc for lighthouse purposes; but a more correct judgment might have been come to if the relative quantities and intensities had been kept apart." Probably some of our readers may like to say something on this highly interesting and important point.

**The Radiphone.**—Prof. Bell's experiments with regard to the photophone have led the way to an instrument of a still more remarkable character. The new "Radiphone" enables sounds to be transmitted by means of a beam of light without any electrical apparatus at all. The transmitter consists of an arc lamp, from which a parallel beam of light is directed upon a mirror, where it is reflected to the distant station. This reflecting mirror is a disc of very thin glass, silvered on its reverse side, and held in a heavy brass frame by means of washers of ordinary blotting paper. A speaking tube communicates with the back of the mirror, and the sounds cause a corresponding vibration of the thin glass, which, in turn, produces slight alterations in the direction of the reflected light. The receiver is a parabolic mirror, at the principal focus of which is a bulb tube containing burnt cork. A hearing tube is connected to this bulb tube, and the sounds heard are said to be very apparent, though not altogether articulate, reproductions of those uttered upon the transmitter. The *Electrical World*, N.Y., gives a sketch of the apparatus. The explanation must not be looked for in the actinic phenomena; the sounds are probably due, we take it, to the variations of pressure within the bulb tube, as the air within it is alternately heated and cooled by the vibratory incident beam.

**Electric Heating and Cooking on Ships.**—The current number of the *Transactions* of the North-East Coast Institution of Engineers and Shipbuilders contains a report of the readjourned discussion of Mr. L. Newitt's paper on "Ships' Electrical Fittings."* In this paper *inter alia* attention was specially drawn to the heating effects of the electric current, and to applications of it in warming cabins and cooking food. Cabins, up to the present time have been heated either by stoves or steam pipes; the former and their attachments are very inconvenient on board a rolling ship, for ashes and smoke are cause of great discomfort; and the latter are also objectionable in that they are liable to get out of order through leakage, stoppage, corrosion, &c. With the introduction of electricity all these inconveniences disappear and a perfectly dry heat (capable of having its hygroscopic properties regulated) is obtained free from draught and the attendant disadvantages which are associated with other means of heating. Mr. Newitt believes that electric cooking and heating will before long be recognised as necessitous on board the great floating palaces which ply between this country and America, and especially, too, on board ships which have to pass through the tropics. As regards cost, this is aboard ships like the great liners a matter subservient to convenience. As to the convenience of electric heating and cooking there cannot be a doubt, and in the matter of cost Mr. Newitt is sanguine enough to believe that under the circumstances it would compare very favourably with other systems, and that the additional load on the engines when so many thousands of horse-power are provided for would scarcely be felt. He enters into calculations the results of which support this affirmation. It must be admitted, however, that the data available for use in such calculations are not very numerous and cannot be regarded as absolutely reliable.

* See ELECTRICAL REVIEW for July 7th, 1893.

**Electric Car Accident in America.**—A Central News telegram from New York on Monday last says:—A serious accident occurred to an electric street car in Cincinnati yesterday evening. The car was proceeding at a rapid rate down a steep hill, when it left the rails, and almost immediately overturned. The car, which was crowded with passengers at the time, was completely wrecked, and when assistance arrived, it was found that two of the passengers had been killed outright, and six others fatally injured, while 40 persons had received injuries of a serious nature.

**The Heat of Dielectric Polarisation.**—In a recent paper by A. Kleiner, entitled "Neber die Durch Elektrische Polarisation," an investigation of the heat produced in insulators by dielectric polarisation is described. A plane condenser, formed of a plate of the substance under examination, and provided with a tin armature on each of its faces, was submitted to a rapid succession of charges and discharges. The elevation of temperature was measured by means of a small thermo-electric couple soldered to one of the armatures. Experiments were carried out with mica, gutta-percha, glass, paraffin, ebonite, wax and caoutchouc; and in every case the elevation of temperature produced by the same number of charges was shown to be inversely proportional to the square of the thickness of the plates emp'oyed. Kleiner deduces that the quantity of heat produced by each charge is proportional to the square of the quantity of electricity brought into play, or, in other words, the energy developed in the armatures. Other things being equal, the absolute value of this quantity of heat varies from one dielectric to another, but always remains almost of the same order of magnitude.

**The Congress at Chicago.**—The *Electrical World* for August 26th gives as complete a list as possible of the papers that were to be read before the Congress, classified according to section:—Section A.—On a Determination of the Velocity of Propagation of Electrical Waves in Wires, by Prof. A. G. Webster; Method in Scientific Nomenclature, by E. Hospitalier; Explanation of the Ferranti Phenomenon, by Dr. J. Sahulka; On the Analytical Treatment of Alternating Currents, by Prof. A. Macfarlane; On Measuring the Power of Polyphase Currents, by A. Blondel; Complex Quantities and their Application in Electrical Engineering, by Chas. P. Steinmetz; General Discussion of the Current Flow in two Mutually Related Circuits containing Capacity, by Drs. Bedell and Crehore; Periodic Variation of the Candle-Power of Alternating Arc Lights, by Prof. B. F. Thomas. Section B.—Some Measurements of the Temperature Variation in the Electrical Resistance of a Sample of Copper, by A. E. Kennelly; Various Uses of the Electrostatic Voltmeter, by Dr. J. Sahulka; The Action of Elihu Thomson's Transformer-Motor, by Dr. J. Sahulka; Iron for Transformers, from the Magnetic point of View, by Prof. J. A. Ewing; On a Method of Governing the Electric Motor for Chronograph Purposes, by Prof. A. G. Webster; On the Construction of Cables for Subterranean High-Tension Circuits, by Dr. A. Palaz; Transformer Diagrams Experimentally Determined, by Dr. F. Bedell; London Electrical Engineering Laboratories, by Prof. A. Jamieson; On the Sources and Effects of Harmonics in Alternating Circuits, by Prof. H. W. Rowland; A Pair of Electrostatic Voltmeters, by Prof. H. S. Carhart; On the Maximum Efficiency of an Arc Lamp with a Constant Number of Watts, by Prof. H. S. Carhart; On Direct Current Dynamos of very High Potential, by Prof. F. S. Crocker; On an Improved Instrument for Measuring Magnetic Reluctance, by A. E. Kennelly; Ocean Telephony, by Prof. Silvanus P. Thompson; Signalling through Space by Means of Electro-Magnetic Vibrations, by W. H. Preece; Material for Standards of Resistance, and their Construction, by Dr. Lindeck; Variation of P.D. of the Electric Arc, with Current, Size of Carbons and Distance Apart, by A. Yerton. Section C.—Rotary Mercurial Air Pumps, by Dr. Shulze-Berge; A Hundred-Hour Electric Arc Light, by Prof. L. B. Marks; The Conversion of Alternating into Continuous Currents, by Dr. Pollak; The Use of Accumulators in Central Stations, by Dr. Pollak; Underground Electric Construction in the United States, by Prof. D. C. Jackson; A New Incandescent Arc Light, by Prof. L. B. Marks. Nikola Tesla delivered a lecture on Friday evening, August 25th, in one of the halls on the World's Fair grounds.

**The Accident at Leeds.**—In the remarks in our last issue regarding this accident, we stated that the extent of the voltage could not exceed 2,500. We now understand that the actual voltage was 1,500, there being only 30 lamps in circuit at the time. Further, we gave the insulation of the circuit at over a million ohms. This should have been 500,000 ohms.

**Heat of Ionisation.**—The heat of ionisation is defined by W. Ostwald as the heat change manifested when free metal is converted into metallic ions. In a recent research he has succeeded in calculating the value of the heat of ionisation for a large number of metals, using Thomson's thermo-chemical data, from the electromotive force of cells, in which these metals play a part. We select the following from his list of results :—

| | Atom. cal. | Equivalent. cal. |
|---|---|---|
| Aluminium ... ... ... | + 117·5 | + 39·2 |
| Manganese ... ... ... | + 48·1 | + 24·0 |
| Zinc ... ... ... ... | + 32·6 | + 16·3 |
| Iron (ferrous ions) ... ... | + 20·0 | + 10·0 |
| Iron (ferric ions) ... ... | − 12·1 | − 12·1 |
| Copper (cupric ions) ... ... | − 17·5 | − 8·8 |
| Copper (cuprous ions) ... ... | − 17·0 (?) | − 17·0 |
| Mercury ... ... ... ... | − 20·5 | − 20·5 |
| Lead ... ... ... ... | − 1·0 | − 0·5 |

All the metals that easily form ions have positive heats of ionisation ; the others have negative heats of ionisation. Full details and tables of results will be found in the *Zeits. Physikalische Chemie*, V. xi., pp. 501—514.

**The Reduction of E.M.F. of Elements by added Substances.**—It appears that when a few drops of a solution of iodide of potassium are added to the liquid in an element of zinc, sulphuric acid, and mercury, the electromotive force is very considerably lowered in value. The phenomenon has recently been investigated by H. Brandenburg, who placed a large number of substances under examination with regard to this property. He has observed it with the following substances, namely : Potassium, bromide, chloride, sulphide (this substance reduces the difference of potential from 1·4 to about 0·2 volt), cyanide, thioacetate, selenocyanate, thiocyanate, nitrite, ferrocyanide, and sodium selenothiosulphate, thioglycollate, thiosulphate, thiophenolate, and succinimide. The research is made the subject of a long paper in the *Zeit. Physikalische Chemie*, V. xi., pp. 552—576. The general conclusion which Brandenburg draws from his observations, is that the action of these substances in lowering the difference of potential of such an element as the above, may be described as due to their removal of mercury ions, and such ions are present in small quantity in the sulphuric acid, and they are removed by the added substances forming insoluble compounds, or double salts, with them, from which compounds or salts mercury is not dissociated as an ion.

**The Nature of Solutions.**—Without depreciating the importance of the facts which have been elicitated of late years as to the nature of solutions by the study of weak solutions, it may be safely predicted that their true nature will never be satisfactorily elucidated so long as investigation is confined to limiting cases where many of the phenomena —perhaps the most important—are necessarily reduced to insignificance, and so long as solutions of all strengths are not embraced in the study. By making the study more comprehensive, Mr. S. U. Pickering has already succeeded in showing that the fact that molecular depression (Raoult's phenomenon) in the case of non-electrolytes diminishes considerably as the concentration increases, is in contradistinction to the behaviour of electrolytes, where, excepting in very weak solutions, the depression increases with the strength. Mr. Pickering has recently made an important contribution to our knowledge of strong solutions, and it is to be hoped that other scientists will also turn their attention to this subject. By accumulating a large number of accurate observations, it may before long be possible to throw a strong light on those obscure problems which exist in the science of chemical physics. These problems are particularly fascinating, because upon their elucidation depends, in all probability, the true explanation of the *rôle* of electricity in electrolysis and similar phenomena.

**Telephonic Communication between Norway and Sweden.**—Telephonic communication between Stockholm and Christiania was opened last Saturday. The line is under the control of the authorities of the United Kingdoms.

**Helsingborg Central Station.**—The central station at Helsingborg, which was erected in 1891 by Siemens and Halske, of Berlin, has hitherto used exclusively engine and dynamo, as it seemed advisable under the conditions then prevailing. As the central is no longer able to meet the consumption without using the necessary reserve, an extension by means of accumulators has been projected. The execution of this enlargement has been entrusted to the same firm. They are setting up a battery of accumulators of 130 Tudor cells, of the capacity of 280 ampère hours, along with the necessary dynamos, apparatus, &c., so that the station will shortly be in a condition to supply current for about 2,000 16 normal candle glow lamps, burning simultaneously.

**The Heilmann Electric Locomotive.**—Mr. B. H. Thwaite writes to the *Engineer* as follows :—"The following occurs in a letter received from my friend, Mr. C. Brown, of Bâle :—'It may interest you to hear that the big electric locomotive was started last Monday ; it runs wonderfully sweet, the faster she goes the smoother, the disturbing influences of the reciprocating masses being entirely eliminated. No counterweights in driving wheels, but a steady tangential pull at the tyres. This added to the compensating action of the compound bogies, combined, produce a locomotive which runs with phenomenal smoothness. You can hold a glass full of water, standing on the driving platform, without spilling a drop, or even producing a ripple on the surface. The movement is even less than in a first-class Pullman. It quite took the breath out of the railway engineers on the footboard, they could scarcely believe their eyes, their other senses failing to impress them that the engine was actually running.'"

**Hague Central Station.**—The electrical central station at the Hague, Holland, erected in 1889 by Siemens and Halske, has repeatedly required enlargement. This year again a large extension has become necessary, which has also been carried out by the same firm. Two Siemens internal pole dynamos, each for 160,000 watts, have been newly erected, and the old small battery of accumulators is exchanged for a new larger battery, of the capacity of 286 ampère hours. The two dynamos are directly connected with a 235 H.P. compound steam engine. The erection of a new boiler with a heating surface of 172 square metres has become necessary. The steam engine, like that previously in action, is supplied by Storch Bros. & Co., of Hengelo, and the boiler by the firm L. & C. Steinmüller, of Gunnersbach, and the battery of accumulators by the Joint Stock Accumulator Company, of Hagen. After the completion of the extension this year, the station represents about 1,000 H.P., of which about 900 H.P. fall to the share of the engines, and about 100 to the accumulators.

**The New Pacific Cable.**—The *Daily Chronicle* correspondent at Tasmania writes as follows :—"Not only in this colony, but in Victoria and New Zealand, there is considerable anxiety as to the outcome of the protest which the Tasmanian Government has submitted to the Imperial Government in relation to the New Caledonia cable. The Governments of these three colonies claim that the Governments of New South Wales and Queensland have acted in a distinctly anti-federal and anti-imperial spirit in giving a guarantee to the French Telegraph Company to lay a cable between Queensland and New Caledonia, as the first section of a trans-Pacific line, and it is hoped that the intervention of the Imperial and Colonial Governments may yet prevent, at least, the extension of the New Caledonian section across the Pacific. The desire of the protesting colonies—and it was previously hoped of all Australasia—was that the new Pacific cable should pass over British or neutral territory, and be quite independent of all foreign complications. This, of course, is made impossible under the French scheme, while the arrangements made with the authorities of Samoa and Hawaii distinctly stipulate that no other cable shall be landed there besides this one for a long term of years."

**Worcester Workhouse Lighting.**—The Board of Guardians last week had this question up before them again. A member moved that the resolution of the Board adopting gas for the new workhouse should be rescinded, and that electricity should be adopted. The motion was, however, lost by 11 votes to 9.

**New Romsey Lighting.**—Owing to a disagreement between the Corporation of New Romsey and the gas company as to the price, the company has removed all public lamps, and the town is now in darkness. On Wednesday night an attempt was made to light the streets with candles, but it proved an utter failure. Tenders have been received by the Corporation for an oil illumination. We would suggest that the authorities adopt what is undoubtedly merely an evolutionary course, and go in for an electric lighting installation.

**The Great Northern Railway and the Electric Light.**—The Great Northern Railway are going to light their two principal stations in the London system by electricity; the stations at Finsbury Park and King's Cross. The electricity will be generated at large works the company have built at Finsbury Park, where also they manufacture compressed gas, and the power will be conveyed in cables to King's Cross station. The cables are being put under ground on the up line of metals, and are very carefully insulated, so that the induction shall not affect either the telegraph or telephone lines alongside them.

**"Lightning."**—Our contemporary of this name in yesterday's issue, has, in its attempts to carry its system of carping criticism to the utmost extent, made a decided blunder. It says:—"The substance of Mr. W. H. Preece's Chicago address was published in most of the technical papers at the time the experiments were tried, but that is no reason why it should not be published again; it makes good padding when copy is scarce, and has an imposing title." To the first portion of this statement we are able to give a point blank denial, as a gentleman closely connected with the REVIEW had a considerable share in assisting at the experiments in question.

**The Municipalities and the Telephone.**—The *Times* of yesterday contains a well written article on the position of municipal bodies with reference to telephones. While there is much in it with which we are compelled to disagree, there are some sensible remarks on the evil of competition which might arise between municipalities and a department of the State. The article is concluded with the following: "The only question is, How can the public gain the greatest advantages from the instrument, having regard to the fact that the telegraphs are in the hands of the State? Many will hold the answer to be that the State should take the telephone also, even though it may have to pay somewhat dearly for past mistakes of policy. The alternatives are either to force the National Telephone Company into the streets of unwilling municipalities, or to bring these municipalities into the field of telegraph work as competitors with the State."

**Electrometric Analysis.**—An ingenious adaptation of the electrometer to volumetric chemical analysis has been made by R. Behrend, the value of which for accentuating precision of observation will be evident from the following example of its use:—A two-fluid cell is constructed, having as electrodes mercury, and for liquids solutions of mercurous nitrate and potassium chloride. With such a cell a large electromotive force will be observed between the two poles, on connecting the cell with a sensitive electrometer. If now a solution of mercurous nitrate is added from a burette to the solution of potassium chloride, the E.M.F. sinks at first slowly, but at a slightly increasing rate, according as more mercurous nitrate enters the liquid, until at the point when all the chlorine present has been precipitated by the mercurous salt, it suddenly falls almost to zero. This phenomenon indicates the point at which equivalent quantities of the reagents are present. Thus the amount of chlorine present can be determined by titration with mercurous nitrate. Similar results can be realised with silver salts and silver electrodes.

**Kendal and Electric Lighting.**—A member of the Town Council had given notice of his intention to move at last week's meeting that an electric lighting committee be formed to go into the question of applying for a provisional order for lighting the borough, and report. Owing, however, to his inability to be present, the matter was deferred until the next meeting.

**The Earth as a Return.**—Prof. A. F. McKissick, of the Alabama Polytechnic Institute, has recently experimented on the availability of the earth as a return conductor for electric railways. The results were so variable, that the Professor concludes that the resistance of the earth is a very unknown quantity, and the assumption that the resistance of the earth can be neglected in any soil is an unsafe one when the object in view is to transmit currents without much loss.

**Steam versus Electricity.**—At North Abington, Mass., the electric railway company want to cross the steam railroad track, much to the railway company's annoyance. Some days ago the railway company attempted to stop the electric line from crossing the points. A free fight ensued, the townspeople backing up the electric railway company. A dozen men were badly hurt, and much damage was caused to property. The Courts have restrained the railway officials from interfering with the operations of the electric line.

**Electric Railway Accidents in America.**—In no other civilised country but America would there be the somewhat callous indifference to street car accidents which characterise the States. Judging from recent remarks of trans-Atlantic contemporaries, most of the accidents on electric lines are due to incompetent men in charge of the cars. The New York *Tribune* insists on the proper training of "motormen," and says that while no man, unless properly trained, is allowed to run a steam engine, men who know absolutely nothing about their work are permitted to run electric cars.

**Blackpool Electric Tramways.**—Attention was called at the Blackpool Town Council meeting on Tuesday morning to the electrical engineer's report upon the Corporation electric tramways, and his statement that the trams could not be successfully worked on the present system. The line cost too much to maintain, and the Council were asked to remember that they would of necessity be called upon to adopt some other system of working the trams.

**Clerkenwell Electric Lighting.**—At a recent meeting of the Clerkenwell Vestry a letter was read from Mr. Sydney Morse, asking the consent of the Vestry to an extension of time till the beginning of next year for carrying out the County of London electric lighting provisional order. A member remarked that it was evident the company were only keeping up the right for the purpose of selling. The Vestry resolved not to grant the request.

**Exhibitors and Exhibits.**—The New York *Electrical World*, in a recent issue, touches upon an important point that has more than once called for attention on this side of the Atlantic, as well as in America. Many of the electrical exhibitors at the Chicago Exhibition have either left no one at all in charge of their stands, or, what is more frequently the case, they have left their entire exhibit in the hands of a general labourer, who is almost entirely ignorant of the working of the apparatus, and perhaps even the names of the articles on show. It is too often the case that exhibitors are satisfied with the attendance of some individual for the mere purpose of cleaning their exhibits and seeing that they are not interfered with by spectators or others. Our New York contemporary calls this a short-sighted policy, and such it undoubtedly is. A mere sight of the things may be satisfying to the disinterested non-technical visitor, but the technical man and the student desire to examine the general and detailed working, construction, and so forth, of the apparatus. There are, it is said, perhaps a dozen exhibits of merit in the Electricity Building where no attendants at all are to be found. Of course it is very bad policy on the part of exhibitors, as they will be the losers in the long run, by neglecting to turn to good account what might otherwise prove profitable business.

**Salford Electric Lighting.**—A Local Government Board enquiry is to be held on 19th inst. regarding the Corporation's application to borrow £50,000.

**Blackpool Electric Lighting.**—The electric lighting installation is now nearly completed. The current was turned on for the first time on Thursday last week.

**Government and the Telephones.**—Telephones have occupied the attention of members of Parliament a good deal of late. The following questions were asked in the House last Monday :—

Mr. A. O'CONNOR asked the Postmaster-General whether the policy of the Department, with reference to the granting of telephone exchange licenses, was that no new license should be granted unless with consent of corporations and municipal authorities, and, if so, whether any application had been made with such consent; what statutory powers, if any, the present private telephone company possessed; and whether, in pursuance of the policy recommended by the Treasury in their minute of May 23rd, 1892, which stated that the object was to meet as far as possible the views of municipal authorities, any application had been made by a corporation, and, if so, from what corporation.

Mr. A. MORLEY: In answer to the first paragraph, I would refer the hon. member to the Treasury minute laid before the House of Commons on May 27th, 1892:—"For a license to establish an exchange in a particular town no application will be entertained unless a formal resolution in its favour has been passed by the corporation or other municipal authority, and evidence given that there is sufficient capital subscribed to carry out the undertaking." In one case a resolution of this kind qualified by conditions has been conveyed to me by the applicant for a license. The telephone companies possess no statutory powers. Application for a license has been made by the Corporation of Glasgow.

In reply to Captain M'Calmont,

Mr. A. MORLEY said: By the terms of the Treasury minute of May 23rd, 1892, in the event of a license being given to a new company, one of the conditions would be that their system must be constructed of metallic circuits. With reference to the remainder of the question, I may say that I am engaged in carrying out the policy of the late Government, who had before them expressions of public dissatisfaction, as well as the question of the effect of the telephone system on the telegraph revenue. It was no doubt with the intention of protecting the public interest that they decided to acquire the trunk telephone lines, and to place certain additional facilities at the disposal of the public. Their proposals were considered and approved by the House of Commons.

In the matter of the National Telephone Company,

Mr. HENNIKER HEATON asked the Postmaster-General whether he had any objection to state the period for which the agreement with the National Telephone Company would be made; and whether the *maximum* ratio to subscribers would be inserted in the agreement.

Mr. CAYZER asked the Postmaster-General whether he would undertake to submit the agreement negotiated between the department and the National Telephone Company to Parliament for approval, in order that its terms might be properly considered in the public interest; and whether, in view of the fact that a twin-wire metallic circuit was absolutely necessary, he was making the adoption of such system by the present private company operating the telephones a condition in the agreement he was negotiating with such company.

Mr. A. MORLEY: I would explain that it is not proposed to confer a new license on the company; the date for the termination of their license is December 31st, 1911, and that date will remain undisturbed. So also will the freedom they at present exercise in fixing their charges for telephone exchange wires. The main object of the new agreement is the purchase of the trunk lines and the consequent withdrawal of the right of the company to erect and work such lines. As to the submission of the agreement to Parliament, I must refer to the answers which I gave in this House on July 31st and the 18th and 31st ult.

Mr. T. G. BOWLES, in reference to an answer previously given by the Postmaster-General on this subject, to the effect that the agreement would be laid on the table of the House when completed, in accordance with the recommendation of the committee, now desired to ask the right hon. gentleman whether it was not a fact that the recommendation of the committee did not include the words "when completed." Did the committee, in the view of the right hon. gentleman, intend that the agreement should be laid on the table only after it was completed?

Mr. A. MORLEY: Yes.

In answer to a further question by Mr. A. C. MORTON,

Mr. A. MORLEY stated that the agreement would not affect the powers of local authorities over streets in which they had control.

Mr. PROVAND wished the Postmaster-General to state distinctly whether the words "when completed" were in the report; and if so, where? He would also like the Postmaster-General to inform the House whether this was not similar to any other agreement for mail contracts or services over the sea, which did not take effect or become operative till they had received the approval of the House.

Mr. A. MORLEY: I believe that is by statute.

Mr. HENNIKER HEATON desired to know whether the Postmaster-General would state what was the application which had been made to him by the Corporation of Glasgow, and what answer was given.

Mr. A. MORLEY: My answer was that the whole matter would receive attention.

**Electro-therapeutics.**—Among the papers to be read before the American Electro-therapeutic Association, at Chicago, this week, is one by Mr. H. Newman Lawrence, M.I.E.E., of London, upon "Electro-Medical Eccentricities."

**Appointment.**—Many applications were received for the post of clerk of works at the Hampstead electric lighting station, and from the 12 chosen to be interviewed, Mr. R. Friend, of Peckham, was selected. The salary is £182 a year.

**The Smoke Nuisance.**—Under this heading "Lyncombe" writes to the *Bath Herald* complaining very bitterly of the unpleasantness caused by the smoke emitted from the chimney at the Bath Electric Light Company's central station.

**A Contemporary Fined.**—On Friday last, at the Mansion House, Mr. George Tucker, manager of the *Electrician* Printing and Publishing Company, was summoned by Mr. R. E. Graves, Inspector of Factories, on five summonses, for being the occupier of a factory wherein on August 25th certain women were employed before 6 o'clock in the morning, contrary to the Factory and Workshop Act, 1878. Sir Andrew Lusk imposed a fine of £1 on each of the summonses, and £1 3s. costs.

**English Electricians at Chicago.**—A week or so ago, a dinner and enthusiastic reception were given at Chicago in honour of Mr. W. H. Preece, Mr. Alex. Siemens, and Prof. Jamieson, who were present there for the purpose of attending the International Electrical Congress. The entertainment was given by the officials of the Commercial Cable and Postal Telegraph Companies. Among those present there figured Dr. Bottomley, Messrs. Kennelly, Sprague, Cutler, Cuttriss, and a number of other well-known men of the American electrical world. Mr. Edison and Nikola Tesla were among those who sent regrets at being unable to attend.

**The American Press on Prof. Jamieson.** — Prof. Jamieson, while visiting the Chicago Exhibition, has caught the fancy of the American newspaper man. A portrait (save the mark) of him appears in the Chicago *Daily Tribune*, accompanied by the following graceful tribute :—"Prof. Jamieson is Professor of Electrical Engineering in the Glasgow and West of Scotland Technical College. He has had vast experience in electrical engineering in important positions. He also has an accent so broad he has to turn it up on edge to get it through an ordinary doorway. Prof. Jamieson enjoys the distinction of possessing the most picturesque hirsute adornment in the whole congress."

**The Conductivity of Mixtures.**—A series of measurements of the conductivities of a large number of mixtures, chiefly of an organic character, has recently been made by D. Konovaloff, who selected mixtures of weak bases, such as aniline and weak acids, such as acetic acid. The results are made more instructive by the method adopted of plotting curves in which the abscissæ are the percentage compositions of the mixtures, and the ordinates their electrical conductivities. An inspection of these curves shows that for each pair of substances the conductivity starts from the neighbourhood of zero for the pure base, and rises to a maximum as acid is added, finally diminishing to zero again for the pure acid. D. Berthelot has made a similar and exhaustive study of the electrical conductivities of phosphoric acid and of alkaline phosphates. His conclusion is that the conductivities of the monobasic potassium and ammonium phosphates are identical; with the bi-basic phosphates the conductivity of the ammonium salt is about 6 per cent. lower than that of the potassium salt, whilst with the bi-basic phosphates the two conductivities differ widely, that of the potassium salt being far above that of the ammonium salt.

## NEW COMPANY REGISTERED.

**British Volta Electric Glow Lamp Company, Limited** (39,507).—This company was registered on the 31st ult., with a capital of £2,000 in £1 shares, to carry on

the business of manufacturers of incandescent electric lamps, and dealers in electric, telegraphic, and telephonic apparatus of all kinds; also to carry on the business of a telegraph, telephone, and electric light, heat and power supply company. The subscribers (with one share each) are: A. T. Turnay, Berghill Road, Sydenham, electrical engineer; G. White, Great Missenden, Bucks, surveyor; E. C. Lacey, 121, Knight's Hill, S.E., manufacturing chemist; G. Willard, 47, Forest Lane, E., electrician; W. Habgood, 49, Queen Victoria Street, E.C., electrical engineer; H. Foster, 87, Grange Road, Bermondsey, India-rubber manufacturer; W. C. Steinbridge, Iliffe Street, S.E., accountant. Several of the regulations of Table A are included in the articles of this company. The directors are never to be more than five in number; qualification, 20 shares at least; remuneration not yet determined. Registered by Jordan & Sons, 120, Chancery Lane, W.C. Registered office, 49, Queen Victoria Street, E.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Telephone Company of Egypt, Limited.**—From the annual return of this company, it appears that out of a nominal capital of £100,000 in 16,000 preferred and 4,000 deferred £5 shares, 12,071 preferred, and the whole of the deferred shares, have been taken up. There has been £5 called on 71 preferred, and the total amount of calls equals £355. A sum of £60,000 on 12,000 preferred and £20,000 on 4,000 deferred shares has been considered as paid.

**African Direct Telegraph Company, Limited.**—According to the annual return of this concern, lately filed at Somerset House, it is shown that out of a nominal capital of £300,000 in £10 shares, 23,600 shares have been taken up. A sum of £236,000 has been received on account of the calls made.

**United River Plate Telephone Company, Limited.**—The annual return of this company has been duly filed at Somerset House. The original capital of this company was £500,000 in £5 shares; and out of this 58,000 shares have been taken up, the full amount having been called upon 42,000 of them. The amount of calls remitted reaches £210,000 and £80,000 has been agreed to be considered as paid.

**Telegraph Manufacturing Company, Limited.**—The annual return of this company was made a short time ago, and shows that out of a nominal capital of £50,000 in £10 shares, 2,800 shares have been taken up with the full amount called upon each. The total sum of calls received is £21,540, and £6,460 has been agreed to be considered as paid.

**Siemens Brothers & Co., Limited.**—This company has recently filed its annual return, and from this document it appears that of a capital of £500,000 in £100 shares, the whole has been taken up. An amount of £85 has been called on each share, and £425,000 has been received on this account.

**Wynne's Electric Closed Tube Tramways, Limited.**—The annual return of this undertaking was filed on the 18th of last July. From it, it seems that 54 shares, out of a nominal capital of £6,000 in 60 £100 shares have been taken up. The total amount of calls received equals £2,130, and there has been a sum of £3,200 agreed to be considered as paid.

**Single-Wire Multiple Telephone Signal Company, Limited.**—The annual return of this company has been filed up to a recent date, and shows that 254 shares, out of a capital of £5,000 in £10 shares, have been taken up. A sum of £2,540 has been paid.

**Swinburne & Company, Limited.**—The statutory return of this concern, as filed at Somerset House, reveals the fact that out of a nominal capital of £25,000 in 300 deferred and 4,700 ordinary shares, all of £5 each, all the deferred and 1,686 of the ordinary shares have been taken up; 200 deferred shares have been issued as fully paid, and £2 10s. has been considered as paid on 660 of the ordinary shares. The full amount has been called on the remainder of the deferred shares, £3 per share on 1,026 ordinary shares, and 10s. per share on the 660 ordinary shares. The calls remitted reach £3,908.

**Western Counties Electric Light and Power Syndicate, Limited.**—The annual return of this company has just been made, and from it we learn that £25,000 in 500 £50 shares was the original capital. There has been 85 shares taken up, upon which the full amount has been called. The total sum of calls received is £4,250, and that agreed to be considered as paid, £6,000.

**Walsall Electrical Company, Limited.**—This company has lately filed its annual return. From it, it seems that out of a nominal capital of £10,000 in £10 shares, 683 shares have been taken up, with the full amount paid on 483, and considered as called on 200 shares. The total sum of calls received reaches £4,780.

**Thetford Electric Light and Power Company, Limited.**—The last annual return of this company shows that out of a nominal capital of £5,000, in £10 shares, 368 shares have been taken up. An amount of £8 has been called on 368 of these; £2,921 has been received on account of the calls made; £50 has been agreed to be considered as paid on 175 shares, in advance of future calls, and £13 is yet in arrear.

**Syndicate of Electrical Engineers, Limited.**—The annual return of this company has lately been filed. It shows that out of a capital of £10,000 in 1,900 ordinary and 100 founders' shares of £5 each, that 1,081 of the former class have been taken up. There has been £4 called on 1,107 of these; £3,753 10s. has been remitted, £370 has been agreed to be considered as paid on 74 founders' shares, and £274 10s. is still outstanding.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**St. Pancras.**—Tenders for the extension of buildings at the electric lighting station in Longford Street, N.W. Further information will be found among our advertisements.

### CLOSED.

**Burnley.**—The tender of Messrs. Spagnoletti & Crookes for the supply and erection of electrical fittings at the Town Hall, at the sum of £88, has been accepted.

## BUSINESS NOTICES, &c.

**J. A. Berly's Universal Electrical Directory** for 1893 (12th year), 784 pp. This standard work, now under the direct supervision of the proprietors, H. Alabaster, Gatehouse and Co., contains a larger amount of trade information than any other similar publication, and should be in the hands of every engineer and electrician. Free within the Postal Union for 4s.

**Lambeth Electric Lighting.**—Mr. W. H. Preece's report upon the proposal to light Lambeth Workhouse and Infirmary by electricity was presented to the Board of Guardians last week. The following are some extracts from the report: "I should judge from the inspection that I have made that we shall need to fix some 1,750 electric glow lamps of 16-candle power or their equivalent in the two buildings under consideration. 1,000 will be needed for the workhouse, and the remaining 750 for the infirmary. . . . . I will assume that the 1,000 lamps in the workhouse will burn an average of 700 hours per annum, and the 750 lamps in the infirmary, 2,100 hours per annum. The consumption of electrical energy on this assumption would be: In the workhouse, 42,000 supply units per annum; in the infirmary, 94,500 supply units per annum—total, 136,500 supply units per annum. The generating plant must be of sufficient capacity to maintain alight a large proportion of the 1,750 lamps at one time. I should assume that in no case would more than 1,600 lamps be lighted simultaneously. This would mean the employment of engines developing a total of 160 horse-power in their cylinders, and driving suitable dynamos to supply the lamps. At least one set of machinery must also be provided as a spare. I should propose on such an installation as this will be, to fix three steam dynamo sets of 80 horse-power each. Two of these would

supply the full load of 1,600 lamps, and one only would be run during the hours of lighter load (under 700 or 800 lamps), the third set being spare, but taking its turn regularly with the others as a working set. Two steam boilers of large capacity would be needed. One of these would always be in reserve. The capital cost of the installation I estimate as follows:

| | |
|---|---|
| Engines and dynamos ... ... ... ... ... | £2,100 |
| Boilers ... ... ... ... ... ... ... | 800 |
| Steam pipes, pumps, and fittings ... ... ... ... | 500 |
| Lamp installation ... ... ... ... ... ... | 2,625 |
| Main cables ... ... ... ... ... ... ... | 300 |
| Contingencies ... ... ... ... ... ... | 575 |
| Say | £6,900 |

| The working expenses would be— | £ | s. | d. |
|---|---|---|---|
| Cost of production at 2d. per unit, equal to ... | 1,137 | 10 | 0 |
| Maintenance of plant at 0·50d. per unit, equal to | 284 | 7 | 6 |
| Lamp renewals, &c., at 0·25d. per unit, equal to ... | 142 | 3 | 9 |
| | £1,564 | 1 | 3 |

Say £1,600 per annum. To this sum, must, of course, be added the interest on the capital expended, say 3½ per cent. on £6,900, equal to £241 10s., bringing the total annual cost of the installation to £1,841 10s., as against a gas bill of £1,500. Per contra to the increase in cost, must be put the value of the better lighting in the infirmary. If only 600 lamps are fixed in the infirmary, giving a service about equivalent in lighting power to that now supplied, the annual cost will be reduced by £216. . . . I strongly recommend that if the work be decided upon, that the two Galloway boilers that you contemplate fixing should be abandoned, and four new boilers of larger capacity be substituted for the boilers now in use. These should be worked together as one battery to supply steam for all purposes, including the electric lighting. The working pressure should be 120 to 130 pounds to the square inch. . . . . I am decidedly of opinion that an installation of electric light should be put in for your workhouse and infirmary. The extra cost over the present gas bill will be very small indeed. . . . . After some discussion the board adjourned the matter for a month, in order that some further particulars may be obtained from Mr. Preece.

**Whitehaven Electric Lighting.**—The central station at Whitehaven was formally opened on Saturday, the 2nd inst., by Miss Dees, daughter of Mr. J. Gibson Dees, J.P., chairman of the Whitehaven Town and Harbour Trust. The order under which the electric lighting works at Whitehaven have been laid down, was obtained in the session of 1891, the area of supply being the whole of the urban sanitary district. In the summer of 1892, steps were taken by the trustees for putting their powers under the order into effect, and the advice of Dr. John Hopkinson, F.R.S., was obtained. Dr. Hopkinson recommended a scheme by which the whole of the public street and harbour lamps should be lighted by means of glow lamps, and that sufficient plant should be provided for supplying electrical energy to a few of the principal streets for private consumers in addition to the street lighting. Dr. Hopkinson was, thereupon, retained by the trustees to prepare plans, &c., for a plant equal to an output of 165 kilowatts, including four sets of Willans compound central valve engines of the F.F. type, coupled direct to Crompton's dynamos each giving 150 ampères at 240 volts, and a battery of 106 E.P.S. K-type cells with a normal output of 100 ampères at 212 volts. The system of supply is the three-wire for domestic lighting and two-wire at 230 volts for public lamps, which comprise glow lamps run two in series. The cables have been supplied and laid by Messrs. Siemens Bros. and Co., Limited. Steam is generated at a pressure of 120 lbs. per sq. inch by two Lancashire boilers supplied by the Lowra Engineering Co., Limited, Whitehaven. Mr. Dees, in a few introductory remarks, gave a brief history of the undertaking and enumerated a few of the benefits to the ratepayers of the town which he hoped would accrue from the use of the light. After the ceremony, the trustees and the contractors' representatives and a few of the chief officials of the Trust, were entertained by Mr. Dees at the Town Hall. The work has been carried out from its commencement under the supervision of Mr. C. H. Wordingham, A.M.I.C.E., of Dr. Hopkinson's staff; Mr. F. Budd, the able representative of Messrs. Siemens Bros., being the contractor's engineer for the cable laying; Mr. J. A. Montealegre, representing Messrs. Crompton & Co.; while Mr. H. A. Sharps, represented the Electrical Power Storage Company.

**The Electric Light on the Obelisk.**—Some time since St. George's Vestry, Southwark, decided to try the experiment of fixing the electric light on top of the Obelisk, London Road, S.E. The work was duly carried out by the Electric Supply Corporation, but it failed to give satisfaction, and the appliances set up were ordered to be removed. The cheque for the work done has not yet been paid, and at St. George's Vestry, on Tuesday evening, a discussion took place on the subject. The Electric Supply Corporation called the board's attention to the fact that their account for £27 had not yet been paid. The matter was referred to the Road Committee.

**Wrexham and Electric Lighting.**—A special meeting of the Town Council is to be held to consider a letter stating that the Wrexham Electric Light and Power Company, Limited, are prepared in accordance with the offer made by the chairman of the company to the Lighting Committee, on April 25th, to sell the provisional order for £500.

**Liverpool Electric Lighting.**—The success of the electric light in the Town Hall has, so we understand, encouraged the authorities to go a step further. They have lately granted their permission to the Electric Supply Company to run a service line into the municipal offices from the proposed main in Dale Street.

**The Electric Light Extension in Hull.**—Although the time for completing the contract for laying down the mains for supplying the electric light outside the Old Town has not yet expired, the work has been done so expeditiously by Callender's Company that it is practically ready for intending users to connect their premises to the supply. The first premises lighted in the extended area were those of Messrs. Turner & Drinkwater, photographic artists, Regent's Terrace, Anlaby Road. Electric light can be used with great advantage in photography. Not only can it be adapted for actual operating purposes, but for the chemical and mechanical processes necessary for the subsequent developing and finishing, much of which has to be done by the aid of artificial light, purity of atmosphere is essential for the best results, and this is ensured with more certainty by means of electricity than by gaslight. Appreciating this, the London house of the firm named two years ago effected an independent installation at a cost of £2,000, and so admirable have been the results that as soon as the opportunity was afforded of obtaining the light from the Corporation Works at Hull, application was made. Messrs. Turner & Drinkwater were the first applicants, and their's is the first lighted. In celebration of it, a reception was held at the studios. There were present Mr. Harman Lewis, the electrical engineer, who has been so far responsible for the works at Hull, but who left for Wolverhampton last week; Mr. Gibbings, his successor; Mr. C. A. Baker, the resident engineer of Messrs. Callender's Company, and others. Not only the studios, but the dressing-rooms are most elegantly fitted up and decorated, the latter being in Louis XVI. style; and when viewed by the new light the whole presented a very charming appearance. The light has been fitted up all over the premises, and can be utilised for many purposes. The fitting work was done by Messrs. King & Co., of Market Place, Hull.

**Austin & Myers.**—At the Leeds Bankruptcy Court, last Tuesday, Harry Austin and James Myers came up for public examination. Liabilities, £261 18s. 11d.; assets, £79 4s. 6d. The debtors attributed their failure to losses by bad debts and other causes. Austin said in reply to questions put by the official receiver (Mr. Bowling) that he was formerly a mechanic employed at the works of Messrs. Greenwood & Batley. Beyond what he learned at home he had had no previous experience as an electrician. When he began business he turned his bedroom into a workshop. His house rent amounted to 3s. 9d. weekly. Afterwards he opened a proper place of business and took Myers into partnership. Before doing this he borrowed the sum of £70 from his step-father, Samuel Greaves. In July, 1892, the firm borrowed £150 from Mr. Joseph Longley. In January, 1893, too, they borrowed £100, and in April, £25. Longley was given a bill of sale upon which he afterwards took possession. On a private meeting of creditors being called only one creditor put in an appearance. A deed of assignment, however, was prepared with that gentleman as trustee. The offer was 5s. in the pound, but one of the creditors declined to assent, and the petition was accordingly filed. Myers, it was stated, had brought the sum of £50 into the business. The examination was closed.

**The Trent Gas Engine Company, Limited.**—The *London Gazette* contains a notice signed by the chairman of this company, to the effect that at a meeting held on August 23rd, the following resolution was passed:—"That it has been proved to the satisfaction of this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is desirable to wind up the same, and, accordingly, that the company be wound up voluntarily." Robert Mellors, of Nottingham, was appointed liquidator.

**Gas v. Electricity at Swindon.**—At a recent meeting of the New Swindon Local Board, a member suggested that a statement be prepared of the cost of gaslight in the district up to midsummer day last, so that the members might have it for reference when dealing with the question of electric light. The vice-chairman said in the statement they would have to take into consideration that part of the district comprising new streets which were not at present lighted with gas.

**Sell's Directory of Telegraphic Addresses.**—After consideration, the Postmaster-General has given his sanction to Mr. Henry Sell's project of a complete list of registered telegraphic addresses. This work will shortly be issued, and followed by quarterly supplements of alterations, corrections, and additions as supplied by the telegraphic department. As the result of this official approval, the directory will contain twice as many names as the volume hitherto published.

**King, Mendham & Co.**—This firm have a very extensive and interesting exhibit at the Bristol Industrial Exhibition; among other things there are electrometers, galvanometers, Wimshurst machines, medical batteries and coils, electrical time check, switchboards, and a large variety of electric light fittings. There is also an exhibit at this stall of Messrs. Crompton's electrical cooking and heating apparatus; also a number of electric bells and telephones.

**The Electric Light on May Island.**—Yesterday the Lord Provost of Edinburgh and other members of the Board of Northern Lighthouses, accompanied two German officers to May Island for an inspection of the electric appliances in the lighthouse. The visit was in connection with the proposal of the German Government to establish the electric light on Ruegen Island in the Baltic.

**Portishead Lighting.**—A special committee have been considering the lighting of this district, and the report just published by them embodied a letter from the Western Counties Electric Lighting Company, recommending the Local Board to adopt electric lighting. Tenders are to be invited for the lighting of the district by gas for one or three years.

**The Electric Light at the Southampton Free Library.**—At a meeting of the committee last week, the chairman (Mr. P. Morgan, J.P.), reported that £165 2s. 5d. was due to Messrs. Crossley of Manchester, for the gas engine for the electric light at the new building. The librarian stated that for 26 days the consumption of gas was 13,500 feet, or an average of about 515 feet per day. The number of lamps of 16 candle-power was 67. The consumption of gas had been reduced, and it was anticipated by Messrs. Crossley that it would be further reduced. The cost of the electric light was rather less than 6d. per hour. The cost of the electric light itself, worked out at 1¾d. per unit. It was pointed out that, whereas, for lighting, the annual expenditure was £96, if they burnt gas the cost would be £100, but inasmuch as in 10 years the plant would be the property of the town, as it would then have been paid for, the £96 would be reduced by £47 10s., representing a saving of nearly £50 a year. Messrs. Crossley's account was ordered to be paid.

**Portsmouth Electric Lighting.**—At the adjourned meeting of the Town Council held on Tuesday last week, the following notices of motion appeared on the agenda:—Councillor Evans:—"That the account of the receipts and expenditure for the electric lighting committee, both in respect of capital and income, be kept entirely distinct from all other accounts of the Corporation, so that the financial result of the working of the electric light scheme may be clearly seen, and that a statement showing such result be prepared every six months by the borough accountant, and submitted to the Council through the finance committee." Councillor F. G. Foster:—"That inasmuch as the electric lighting of Elm Grove has been decided upon by the Electric Lighting Committee without the knowledge and consent of this Council, it be an instruction to that committee to ask the approval or otherwise of this Council prior to the mains being laid therein, also in any other street or road, other than those already sanctioned by the Council."

**Richard Hornsby & Sons, Limited.**—This firm have commenced upon a large scale to manufacture water-tube boilers under the patents of the Mills Patent Sectional Boiler Company, Limited, of Pendleton, Manchester. Messrs. Hornsby, will, in future, carry on the manufacture of these boilers under the title of the "Hornsby" water-tube boilers. These well-known boilers are made with patent water-lined furnaces (single and double flues), for bituminous and smoky coal, effecting great economy in fuel, and with large brick-lined furnaces for inferior and bulky fuel, or for any fuel requiring large grate area. The boilers are specially adapted for export, as they can be handled in sections where transport is difficult. They are well suited for sugar estates, where bagasse and other refuse can be used as fuel, also for ironworks, where waste heat from furnaces can be used, and, indeed, they are well adapted for any purpose where steam power is required.

**Manchester Central Station.**—Messrs. R. Hornsby and Sons, Limited, of Grantham, have just put down for the Manchester Corporation, at their central electric lighting station in that city, six very fine vertical compound tandem condensing steam engines, and we understand these engines are now running, and giving the greatest satisfaction. They are very well proportioned, and very massive in design, and run with the greatest steadiness. The governing arrangements are very perfect, and control the engines in the most efficient manner. The engines are designed to give off 90 brake horse-power when running at 120 revolutions per minute, and this they do easily. We understand Messrs. Hornsby have supplied a large number of engines for electric lighting purposes in various parts of the world.

**Electric Light at Dundee.**—A Sub-Committee of the Lighting Committee of the Dundee Police Commission held a meeting last week, when the subject of extending the system of electric lighting in the public thoroughfares was considered. The committee were informed that communications had been made with the Gas Commission as the electric lighting authority, and it had been stated that at least 40 lamps would be necessary to efficiently light the central thoroughfares, and that the cost would be about £800 per annum. The question of cost was mentioned; but the members, considering the great advantage which would be derived by substituting electricity for gas, did not think the extra expense should stand in the way. A proposal to light the streets by electricity was to be laid before the Lighting Committee early this week.

**Manchester Electric Lighting.**—A Manchester "daily" asks:—"What has become of the new electric lighting installation by which Manchester was to benefit at the commencement of August? An inquiry at the works whence the light is to be generated led to the discovery that there was no definite knowledge as to the date when the public will be in a position to use the electric illuminant. This is strange when we remember that a Corporation committee was supposed to have expressed final approval of the works over six weeks ago.

**United Telephone Company of Rosario, Limited.**—At an extraordinary general meeting of the above company, held at 78, Coleman Street, on August 10th, 1893, the following special resolution was duly passed; and at a subsequent extraordinary general meeting on August 31st, 1893, the same resolution was duly confirmed as a special resolution:—"That the company be wound up voluntarily, and that T. S. Hamilton, the secretary of the company, be and is hereby appointed liquidator for the purposes of such winding up."

**Change of Address.**—On and after October 1st, the address of the *Revue Scientifique* will be 19, Rue des Saintes-Pères, Paris.

Messrs. Babcock & Wilcox, Limited, notify us that their address from September 1st is 127, Queen Victoria Street, E.C., instead of 114, Newgate Street, as formerly.

**Electric Lighting at Santiago.**—The *Times* states that the Secretary of State for Foreign Affairs has learned from Her Majesty's Minister in Chili that the Municipality of Santiago have expressed a wish to receive tenders for the lighting of that city by electricity. Such particulars as are in the possession of Her Majesty's Government may be seen on personal application at the Commercial Department of the Foreign Office, between the hours of 11 and 6 daily.

**The Telegraph to Brazil Suspended.**—The Eastern Telegraph Company notifies that the Brazilian Government having suspended their international telegraph service, messages for that country cannot at present be accepted. Telegrams for Uruguay, Argentina, &c., can be accepted as usual.

**Elwell-Parker Electric Company, of America.**—A company has been incorporated at Cleveland, O., with this title. It is named after a late English company of a somewhat similar name, has a capital stock of $500,000, and is intended to manufacture and sell dynamos, motors, and other apparatus.

**New Branch.**—The Eastern Telegraph Company, Limited, announces the opening of a branch office at Winchester House, 50, Old Broad Street, E.C., for the acceptance of telegrams for South America, South Africa, Egypt, India, China, Australasia, &c.

**Brentford Workhouse and Schools.**—The Board of Guardians have received four offers from various firms to supply electric light for the workhouse and schools. Consideration of the matter has been deferred.

**Incandescent Lamp Company of Buda-Pesth.**—We understand that this company, which is established at Buda-Pesth, has made a loss of £1,447 on the last financial year's working.

**Personal.**—Mr. Ed. C. de Segundo has resigned the post of consulting engineer to the Weymersch Electric Battery Syndicate, but retains his seat on the board.

**Falmouth Electric Lighting.**—The Lighting Committee have been empowered to obtain a report as to the probable cost of lighting the main streets by electricity.

## CITY NOTES.

### Direct Spanish Telegraph Company, Limited.

THE ordinary general meeting of the shareholders of this company was held on Friday last, at Winchester House, Old Broad Street, E.C.

SIR JOHN PENDER, M.P., presided, and in moving the adoption of the report, after expressing regret at the loss the company had suffered by the death of their late chairman, Sir James Anderson, said that the accounts for the half-year showed, after providing for debenture interest, a balance to the credit of the profit and loss account of £4,645. The traffic receipts showed a decrease of £593 as compared with the corresponding period of 1892. The falling off in the receipts was chiefly due to the stagnation of Stock Exchange business in England, Spain, and France. It was somewhat remarkable that during the last six months, when things were at their very worst, submarine telegraph companies' shares stood a little higher in the market than usual; therefore, their position was sound. The working expenses were £130 in excess of those for the corresponding period of last year. The company's cables, and the land lines in connection with them, had continued in good working order throughout the half year. The result of the half-year's working was that, after adding the usual sum of £2,500 to the reserve fund, the balance of profit and loss amounted to £2,145. To that the directors proposed to add £345 from interest on investments, and recommended the payment of the dividend at the rate of 10 per cent. per annum on the preference shares, and a dividend at the rate of 4 per cent. per annum on the ordinary shares. The reserve fund at the present time amounted to £35,936, £32,000 of which was invested, and yielding them an average interest of 3½ per cent.

MR. EDMUND ETLINGER seconded the motion, which was unanimously agreed to.

## TRAFFIC RECEIPTS.

**The City and South London Railway Company.** The receipts for the week ending September 3rd, 1893, amounted to £745; week ending September 4th, 1892, £737; increase £8; total receipts for half-year, 1893, £7,373; corresponding period, 1892, £6,927; increase £446.

**The Cuba Submarine Telegraph Company.** The estimated traffic receipts for the month of August were £3,000; as compared with £3,166 in the corresponding month of last year.

**The Direct Spanish Telegraph Company, Limited.** The estimated receipts for the month of August, 1893, amounted to £1,670, against £1,884 in the corresponding period of last year.

**The Great Northern Telegraph Company.** The traffic receipts in August, 1893, were £23,200; January 1st to August 31st, 1893, £180,000; corresponding months, 1892, £175,600; corresponding months, 1891, £189,400.

**The Western and Brazilian Telegraph Company, Limited.** The receipts for the week ending September 1st, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,735.

## SHARE LIST OF ELECTRICAL COMPANIES.

| Present Issue. | Name. | Stock or Share.‡ | Closing Quotation August 30th. | Closing Quotation, September 6th. | Business done during week ended September 6th, 1893. Highest. | Lowest. |
|---|---|---|---|---|---|---|
| 184,500£ | African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer | 100 | 99 —102 | 99 —102 | ... | ... |
| 1,134,640£ | Anglo-American Telegraph, Limited ... ... ... ... ... | Stock | 49½ — 50½ | 50½ — 51½ | 50½ | ... |
| 2,932,680£ | Do. do. 6 p. c. Preferred ... ... ... ... ... | Stock | 92 — 93 | 92½ — 93½ | 93½ | 92½ |
| 2,932,680£ | Do. do. Deferred ... ... ... ... ... | Stock | 9½ — 10 | 9⅝ — 10⅛ | 10 1/16 | 9⅞ |
| 130,000 | Brazilian Submarine Telegraph, Limited ... ... ... ... | 10 | 11⅜ — 12⅛ | 11⅜ — 12⅛ | 12 1/16 | 11 15/16 |
| 18,700£ | Do. do. 5 p. c. Bonds ... ... ... ... ... | 100 | 99 —103 | 99 —103 | ... | ... |
| 75,000£ | Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ... | 100 | 107 —111 | 107 —111 | ... | ... |
| 77,978 | Brush Electrical Engineering Ordinary, Nos. 1 to 63,416 ... ... | 3 | 3 — 3¼ | 2⅞ — 3⅛ xd | 3 1/16 | ... |
| 75,000 | Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416 | 2 | 2 — 2¼ | 2 — 2¼ xd | 2⅛ | 2 1/16 |
| 125,000£ | Do. do. 4½ per cent. Debenture Stock ... ... | Stock | 107 —109 | 105 —107 xd | 106½ | ... |
| 20,510 | Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000 | 5 | 5 — 5½ | 5 — 5½ | ... | ... |
| 44,000 | Chili Telephone, Limited, Nos. 1 to 40,000 ... ... ... ... | 5 | 2 — 3 | 2 — 3 | ... | ... |
| 630,000£ | City and South London Railway ... ... ... ... .. | Stock | 35 — 37 | 35 — 37 | 36½ | ... |
| 40,000 | City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ... | 10 | 11 —11½ | 11 — 11½ | 11⅜ | ... |
| 20,000 | Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 | 10 | 12½ — 13 | 12½ — 13½ | 13 1/16 | ... |
| $7,716,000 | Commercial Cable, Capital Stock ... ... ... ... ... | $100 | 120 —130 | 127 —132 | 132 | ... |
| 224,850 | Consolidated Telephone Construction and Maintenance, Limited ... | 14/- | 1/16 — 3/16 | 1/16 — 3/16 | ... | ... |
| 20,000 | Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000 | 5 | 4 — 5 | 4 — 5 | ... | ... |
| 50,000£ | Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each | ... | 98 —102 | 98 —102 | ... | ... |
| 16,000 | Cuba Telegraph, Limited ... ... ... ... ... | 10 | 11½ — 12½ | 11 — 12 xd | ... | ... |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... ... | 10 | 18½ — 19½ | 18 — 19 xd | ... | ... |
| 12,931 | Direct Spanish Telegraph, Limited, ... ... (£4 only paid) | 5 | 2½ — 3½ | 2½ — 3½ | ... | ... |
| 6,000 | Do. do. 10 p. c. Preference ... ... ... | 5 | 8½ — 9½ | 8½ — 9½ | ... | ... |
| 60,710 | Direct United States Cable, Limited, 1877 ... ... ... .. | 20 | 11⅜ — 11⅝ | 11½ —11⅝ | 11⅝ | 11 9/16 |
| 400,000 | Eastern Telegraph, Limited, Nos. 1 to 400,000 ... ... ... | 10 | 14⅞ — 15⅛ | 15 — 15⅛ | 15⅛ | 15 |
| 70,000 | Do. 6 p. c. Preference ... ... ... ... ... | 10 | 16 — 16½ | 16 — 16½ | ... | ... |
| 105,900£ | Do. 5 p. c. Debs. (1879 issue), repay. August, 1899 | 100 | 106 —109 | 106 —109 | 109 | ... |
| 1,294,100£ | Do. 4 p. c. Mortgage Debenture Stock ... ... | Stock | 111 —114 | 111 —114 | 112½ | 111⅜ |
| 250,000 | Eastern Extension, Australasia and China Telegraph, Limited ... | 10 | 15 — 15¼ | 15⅛ — 15⅜ | 15⅜ | 15 5/16 |
| 62,700£ | Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 | 100 | 102 —105 | 102 —105 | ... | ... |
| 222,800£ | Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ... | 100 | 102 —105 | 102 —105 | ... | ... |
| 320,000£ | Do. 4 p. c. Debenture Stock ... ... ... ... ... | Stock | 110 —113 | 110 —113 | 111½ | ... |
| 108,700£ | Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 | 100 | 100 —103 | 100 —103 | ... | ... |
| 146,800£ | Do. do. do. to bearer, Nos. 2,344 to 5,500 | ... | 100 —103 | 101 —104 | 101⅜ | 101 |
| 300,000£ | Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909 | 100 | 100 —103 | 100 —103 | 101¼ | 100 |
| 200,000£ | Do. 4 p. c. Reg. Mt. Debs. (Mauritius Subsidy) 1 to 8,000 | 25 | 102 —105 | 102 —105 % | ... | ... |
| 49,900 | Electric Construction, Limited, Nos. 101 to 45,100 ... ... ... | 10 | 1¼ — 1⅜ | 1¼ — 1⅜ | 1⅜ | ... |
| 19,900 | *Electricity Supply Co. of Spain, Nos. 101 to 20,000 ... ... ... | 5 | ... ... | ... ... | ... | ... |
| 100,000 | Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750 | 2 | 1/16 — 1/8 | 1/16 — 1/8 | ... | ... |
| 91,195 | Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ... | 2 | 1/16 — 1/8 | 1/16 — 1/8 | 1/8 | ... |
| 67,385 | Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd. | 2 | 1/16 — 1/8 | 1/16 — 1/8 | ... | ... |
| 20,000 | Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid) | 5 | 1 — 2 | 1 — 2 | ... | ... |
| 180,227 | Globe Telegraph and Trust, Limited ... ... ... ... ... | 10 | 9⅜ — 9⅞ | 9⅜ — 9⅞ | 10 | 9⅜ |
| 150,042 | Do. do. 6 p. c. Preference ... ... ... | 10 | 15 — 15½ | 15½ — 15⅝ | 15 5/16 | 15 |
| 150,000 | Great Northern Tel. Company of Copenhagen ... ... ... | 10 | 19⅝ — 20¼ | 19¼ — 20¼ | 20⅛ | 20 |
| 200,000£ | Do. do. 5 p. c. Debs. (issue of 1883) ... | 100 | 105 —108 | 103 —106 xd | ... | ... |
| 12,134£ | Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ... | 10 | 4½ — 5½ | 4½ — 5½ | ... | ... |
| 9,600£ | Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000 | 10 | 6 — 7 | 6 — 7 | ... | ... |
| 50,000 | India-Rubber, Gutta Percha and Telegraph Works, Limited .. | 10 | 21½ — 22½ | 21½ — 22½ | 22⅛ | 22 |
| 200,000£ | Do. do. 4½ p. c., Deb., 1896 ... ... ... | 100 | 102 —104 | 102 —104 | ... | ... |
| 17,000 | Indo-European Telegraph, Limited ... ... ... ... ... | 25 | 39 — 42 | 39 — 42 | 39½ | ... |
| 11,334 | International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000 ... ... | 10 | 1½ — 2½ | 1 — 2 | ... | ... |
| 30,000 | †Liverpool Electric Supply, £3 10s. paid ... ... ... ... | 5 | 4 1/16 — 4 5/16 | 4 5/16 — 4 7/16 | 4 7/16 | 4 5/16 |
| 10,000 | Do. do. fully paid ... ... ... ... | 5 | 6⅛ — 6⅜ | 6⅛ — 6½ | 6½ | 5⅞ |
| 37,548 | London Platino-Brazilian Telegraph, Limited ... ... ... | 10 | 4 — 6 | 4 — 6 | ... | ... |
| 100,000£ | Do. do. do. 6 p. c. Debentures ... ... | 100 | 107 —110 | 104 —107 xd | ... | .. |
| 49,900 | *Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid) | 10 | 5⅜ — 6¼ | 6¼ — 6⅜ | 6½ | 6¼ |
| 50,000£ | Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40 | ... | 102 —105 | 102 —105 | 105 | 104 |
| 15,000 | Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ... | 5 | 1½ — 2½ | 1½ — 2½ | ... | ... |
| 28,000 | Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid | 5 | 3 — 4 | 3 — 4 | ... | ... |
| 458,867 | National Telephone, Limited, Nos. 1. to 438,984 ... ... ... | 5 | 4⅜ — 4⅝ | 4⅜ — 4⅝ | 4⅞ | 4⅝ |
| 15,000 | Do. 6 p. c. Cum., 1st Preference ... ... ... | 10 | 14½ — 15½ | 14½ — 15½ | 15⅜ | ... |
| 15,000 | Do. 6. p. c. Cum. 2nd Preference ... ... ... | 10 | 14 — 15 | 14 — 15 | ... | ... |
| 90,950 | Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ... | 5 | 5¼ — 5½ | 5¼ — 5½ | 5 7/16 | 5 5/16 |
| 726,477£ | Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ... | ... | 111 —113 | 111 —113 | 112⅛ | 112 |
| 48,800 | New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid) | 10 | ... ... | ... ... | ... | ... |
| 6,452 | Notting Hill Electric Lighting Company, Limited, fully paid ... | 10 | 5 — 6 | 5 — 6 | ... | ... |
| 220,000 | Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid) | 1 | 3/16 — 5/16 | 3/16 — 5/16 xd | ... | ... |
| 100,000£ | Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000 | 100 | 100 —103 | 100 —103 | ... | ... |
| 11,802 | Reuter's Limited ... ... ... ... ... ... ... ... | 8 | 4½ — 5½ | 4½ — 5½ | 5 | 4 12/16 |
| 19,980 | St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780 | 5 | 6⅛ — 6⅜ | 6⅛ — 6⅜ | ... | ... |
| 20,000 | Do. do. 7 per cent. pref., Nos. 20,081 to 40,080 | 5 | 7⅜ — 8⅛ | 8 — 8⅛ | 8 5/16 | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... ... | Cert. | 115 —120 | 115 —120 | ... | ... |
| 78,942 | Swan United Electric Light, Limited ... ... (£3½ only paid) | 5 | 1⅞ — 2⅛ | 1⅞ — 2⅛ | 2⅛ | 2 |
| 37,350 | Telegraph Construction and Maintenance, Limited ... ... ... | 12 | 32 — 34 | 32 — 34 | 33 | ... |
| 150,000£ | Do do. do. 5 p. c. Bonds, red. 1894 | 100 | 101 —104 | 101 —104 | ... | ... |
| 58,000 | United River Plate Telephone, Limited ... ... ... ... | 5 | 2 — 2½ | 2 — 2½ | ... | ... |
| 146,370£ | Do. do. 5 p. c. Debenture Stock ... | Stock | 90 —100 | 90 — 100 | ... | ... |
| 15,609 | West African Telegraph, Limited, Nos. 7,501 to 23,109 ... ... | 10 | 5½ — 6½ | 5½ — 6½ | ... | ... |
| 260,900£ | Do. do. do. 5 p. c. Debentures ... ... | 100 | 99 —102 | 97 —100 xd | 99 | ... |
| 30,000 | West Coast of America Telegraph, Limited ... ... ... ... | 10 | 2 — 3 | 2 — 3 | ... | ... |
| 150,000£ | Do. do. do. 8 p. c. Debs., repayable 1902 ... | 100 | 97 —101 | 97 —101 | ... | ... |
| 64,242 | Western and Brazilian Telegraph, Limited ... ... ... ... | 15 | 6½ — 6⅝ | 6½ — 7 | 6 13/16 | ... |
| 33,129 | Do. do. do. 5 p. c. Cum. Preferred ... ... | 7½ | 5⅞ — 6⅛ | 5⅞ — 6⅛ | 6⅛ | ... |
| 33,129 | Do. do. do. 5 p. c. Deferred ... ... ... | 7½ | 1⅛ — 1⅜ | 1⅛ — 1⅜ | ... | ... |
| 178,200£ | Do. do. do. 6 p. c. Debentures "A," 1910 ... | 100 | 103 —106 | 103 —106 | ... | ... |
| 222,700£ | Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910 | 100 | 103 —106 | 103 —106 | ... | .. |
| 88,321 | West India and Panama Telegraph, Limited ... ... ... | 10 | 1 — 1⅛ | 1⅛ — 1⅜ | 1⅛ | ... |
| 34,563 | Do. do. do. 6 p. c. 1st Preference ... | 10 | 10½ — 10⅝ | 10½ — 10⅝ | ... | ... |
| 4,669 | Do. do do. 6 p. c. 2nd Preference ... | 10 | 9 — 10 | 9 —10 | ... | ... |
| 80,000£ | Do. do. 5 per cent debentures (1917) No. 1 to 1,000 | 100 | 105 —108 | 106 —109 | 108½ | ... |
| $1,214,000 | Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds | $1,000 | 120 —125 | 120 —125 | ... | ... |
| 169,000£ | Do. do. 6 p. c. Sterling Bonds ... ... ... | 100 | 101 —104 | 100 —103 xd | 102 | ... |
| 59,900 | *Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ... | 5 | 5 — 5½ | 4⅜ — 5½ | 5 | ... |

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

**LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:**—Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 6½—6.—Electric and General Investment, shares of £5 (£1 paid), 1½—2½.—Founders' shares, 200—225.—House to House Company (£5 paid) 1½—2½.—Do. 7 per cent. Preference of £5, 5—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5½—5⅝, 1st Preference Cumulative 6 per cent., £5 (fully paid) 6—6½.—Manchester, Edison and Swan Company £9 (£1 paid), ¼—½.—Queen Anne's Mansions Lighting and Heating 6 per cent. £10 Debentures, 101—103.

Bank rate of discount, 5 per cent. (August 24th, 1893).

## INCANDESCENT LAMP TESTS.*

THE Electrical Jury of Award of the World's Fair has decided upon an elaborate system of tests for incandescent lamps which promises to produce some much-needed data. The scheme as finally adopted and announced is as follows:

The points to be examined are: (*a*) Initial candle-power (mean horizontal). (*b*) Initial efficiency. (*c*) Life test. (*d*) Time at which blackening becomes appreciable and also, if time will permit, resistance, when cold, at various intervals (vacuum test). (*e*) Average efficiency through whole life of lamp.

*Current Supply.*—The Fort Wayne Electric Company has placed an engine and all dynamo machinery necessary at the disposal of the committee.

This machinery will have nothing to do except to supply current to the lamps under test—110-volt lamps will be supplied with direct current, and 50-volt lamps with alternating. Lamps will be placed on racks, on circuits of heavy copper rod, all lamps of a given voltage being on one circuit. Careful provision will be made to maintain voltage constant.

*Standards.*—The English sperm candle for candle-power.

Electrical standards as agreed upon by the sub-committee on instruments.

*Instruments.*—For candle-power measurements, a Lummer-Brodhun photometer; length of bar, 250 ohms; Methven screens using carburetted gas—gas passed through a sensitive gas pressure governor. Carburetter to be filled with gasoline distilled between 35° and 50° C., from 30° gasoline.

The electrical instruments used will be Weston instruments, which will be tested at the beginning of the tests, and at intervals during its progress, by sub-committee No. 1 (on instruments, &c.).

Recording voltmeters (if such can be obtained) will be placed on the life test circuits.

*Scheme of Test.*—The photometer being properly mounted, the Methven screen will be tested by comparison with standard candles. This test being satisfactorily completed, two or more 32-candle-power lamps, of proper voltage and carefully selected with reference to uniformity of radiation in a given direction, will be tested at standard voltage. One of these lamps, so measured, and thereafter designated as working standard, will be placed on the photometer. Each lamp entered for test will then be compared with the working standard, both being carefully adjusted to standard potential. The mean horizontal intensity of each lamp will be obtained, preferably by spinning, when under comparison with the working standard, which latter will be maintained at about 16 candle-power. The candle-power of each lamp in a marked position (azimuth) will also be determined at the same time, and its "position factor" derived. At the same time that the photometric work is done on each lamp, careful readings of potential and current, or of potential and watts, will be taken. It should have been stated earlier that a storage battery of proper size will be used to furnish current to all lamps when under photometric tests, and rheostats and switches in connection with the battery, so that the lamps may be run at the exact voltage intended.

After the initial measurements are made, the lamps, each tagged or otherwise marked with an individual number, will be placed on the rack. The rack or rack section being filled, switches will be closed, time noted, potential carefully adjusted, and maintained constant.

At intervals (as small as convenient in the earlier days of the life test) each lamp will be removed from the test rack, placed on photometer in its "marked position," and readings of candle-power, voltage and current (or watts) taken.

Complete records of all things affecting the tests or results will be kept in proper blank books.

*Results.*—The data of the test will be completed and tabulated so as to show the following points:—

(1) Mean horizontal candle-power, and percentage of initial candle-power, at each reading throughout the test. (2) Efficiency (watts per candle-power) at each reading. (3) Time of breaking of each lamp broken. Curves to express the above relations for the average result of each lot of lamps to be prepared. (4) Average cost of candle-power-hour of light produced by each make of lamp at intervals through its life, such cost to include price of lamp (assumed to be 45 cents per lamp for each make), and cost of current at some figure mutually agreed upon, or at different figures, as charged by central stations in operation.

*Report.*—A report upon the test giving a full account of all points concerning the methods and instruments used, details of machinery and circuits, all original readings, &c., will be formally made to the proper official of the Exposition, with the recommendation that it be printed at the earliest possible date. If prompt printing is not found possible, permission to give the report to the electrical press will be asked.

In answer to the questions of lamp representatives present, it was ruled that lamp representatives would not be allowed to be present during, or to take notes upon, the tests or records of any other tests than their own.

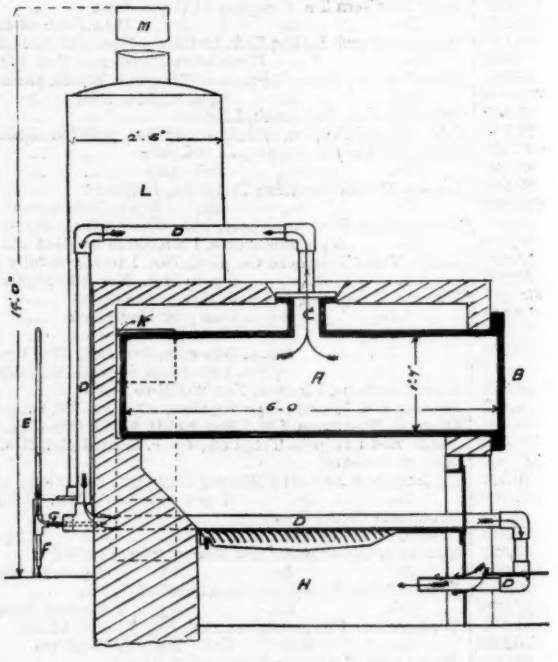
* New York *Electrical World.*

## THE UTILISATION OF TOWN REFUSE FOR POWER PRODUCTION.

BY THOMAS TOMLINSON, B.E., Assoc.M.Inst.C.E.

(*Continued from page* 207.)

TRYING, now, to extract some definite ideas from the mass of conflicting results, opinions and anticipations focussed in the tabular statement given last week (from which the expected result at Widnes, was by accident omitted, it would have come between Hastings and Ealing with 35 I.H.P. hours per ton), one is at once struck by the wide difference between the maximum and minimum figures, and by the apparent impossibility of arriving at any fairly definite conclusions. One cause of this is undoubtedly the varying nature of the material from which the various figures were deduced, and it is much to be desired that some simple, practical, and easily applied standard should be arrived at.




Certain experiments I am now engaged on lead me to believe that such a standard may be possible by the comparatively easy measurement of contained water (estimated by difference after thorough drying) and fuel (cinders, breeze, &c.), which will not pass through a sieve of a certain specified mesh. Calorimeter tests are perfectly useless; carbon dust would give first rate results measured that way, but would be not merely valueless, but detrimental under practical conditions.

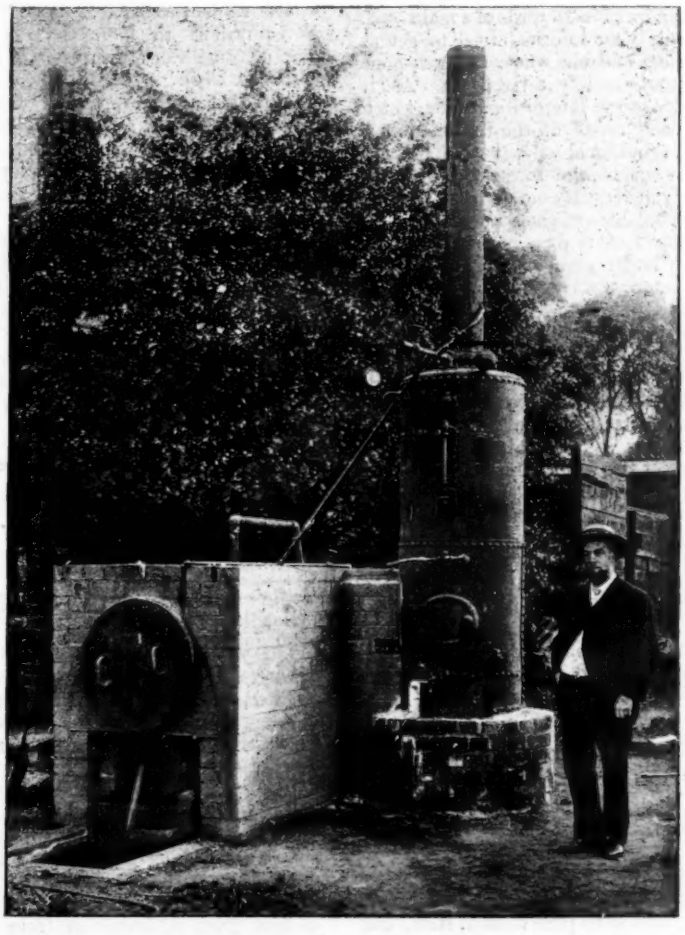
From the results analysed, any engineer can form his own conclusions. It seems to me that the evaporative value of

ashbin refuse, under practical conditions of utilisation, varies from 500 to 800 lbs. of water per ton of refuse burnt; and while I am willing to admit that Mr. Watson's experiment indicates a possibly higher maximum value (1,300 lbs. of water per ton), it would, in my opinion, be unsafe to calculate upon it until the experiment had been repeated and carried out for a much longer time and under the crucial condition of burning everything—except bottles, tinware, and the like—the material to be collected in equal quantities from different localities, rich and poor, of a large town.

Of course, it is perfectly well known that the municipal engineer has other refuse to deal with than ashbin refuse. According to the system of sewage and refuse disposal adopted in the town or district, he has midden or cesspit stuff, pail contents, and air dried or pressed sludge to dispose of.

When I commenced this series of articles, I had no expectation of being able to do more than subject the records and expectations of the performances of the ashbin destructor to analysis, with a view to getting at safe conclusions on the subject, and then following this up with the account of certain laboratory experiments on midden, pail and sludge stuffs, which seemed to indicate methods of disposal and possible results in the direction of available power, which experiments had been suggested by the inquiry of a gentleman as to whether midden stuff could be made available in connection with electric lighting. A fortunate introduction through an old colleague, and the appearance and title of the first article, led to an engagement by Mr. John Hanson, of Wakefield, the well known expert in sewage treatment, to conduct experiments on his retort destructor, and an account of these experiments will, with advantage, take the place of the small scale experiments, except for special purposes.

As this apparatus is new and has not yet been described, a cross section is given to show the details, and a photograph to show the general arrangement. Referring to the lettering of the cross section: A is the retort, 6 feet long by 18 inches diameter; B is the door for charge and discharge; C is the opening for the passage of steam and gas; D is the pipe which conveys this mixed steam and gas through the furnace and under the firebars; E is the steam supply from the boiler; F is the drain pipe, provided with a cock at the lower end; G is a small pipe contracted at its far end, which passes into the pipe, D, through a plug, and acts as an ejector, drawing the mixed gas and steam from the retort; H is the ashpit into which the pipe, D, passes through an annular opening in the door, by which air is drawn in; the space above D shows the furnace, provided with Lord's patent fire-bars; K is the flue which passes downwards under the foundation ring of the boiler, and up through one side of the boiler furnace, the other side of which is divided by a mid-wall, rising to a height of about 4 inches above the fire-bars (Lord's also) with which this other side is provided; L is the boiler, which is vertical, 2 feet 6 inches external diameter, 6 feet 6 inches high, and provided with two cross tubes; M is the chimney which rises to a height of 14 feet above ground level.



The action of the apparatus is extremely simple. The furnace fire having been for some time lit, and also in general a fire in the half of the boiler furnace not occupied by the flue from the main furnace, when the retort is thoroughly hot and the steam in the boiler is at or over 30 lbs. pressure, the retort is charged, and the valve on the steam pipe, E, opened; this creates a slight vacuum inside the retort and draws from it through the pipe, D, the mixed steam and gas, which are given off in the drying, and forces it up through the fire, at the same time the steam issuing from the pipe under the fire-bars draws in through the annular opening in the ashpit door the air necessary for combustion, the inrush of which prevents the outlet of the stinking gases from under the fire-bars.

As has been before insisted upon in these articles, before you begin to talk of getting anything out of a destructor in the shape of power, it must fulfil sanitary requirements, *i.e.*, it must destroy inoffensively; this apparatus fulfils this fun-

damemental requirement admirably. Exit of the evolved gases from the retort (as at the lid joint for example) is prevented by the slight vacuum formed within (there were, in fact, holes with plugs in the lid, and on opening one of these, the smoke from a pipe was seen to be drawn *in*). Exit of the gases from the ashpit was prevented by the inrush of air; and the gases were compelled to pass through the red-hot part of the pipe, D, which passed through the fire (not the best place, but simply the most convenient), then *through* the red-hot fire, where, no doubt, chemical decomposition and breaking up took place, and then through the red-hot furnace. The temperature of the gases in the furnace itself was not taken, but the temperature of the gases in the flue between the furnace and the boiler was frequently taken by a recently-tested pyrometer, and rarely fell below 700° F., and was most frequently above 1,000° F. (the extreme range of the instrument). The most practical proof of the inoffensiveness of the destruction is, however, the fact that a trial run of 65 hours, day and night, during which time 4 tons of midden stuff was destroyed, was conducted with a chimney only 14 feet from ground level, and within 16 yards of a main road.

This 65 hours' run was really an informal trial to get at the proper working conditions, and one whole day was gone before these were even approximately arrived at. As it stands, however, it has yielded some interesting results, which Mr. Hanson allows me to make use of on the understanding that they shall be stated as provisional only, the trial having been drawn to a close to enable him to carry out certain changes which will certainly increase the output per 24 hours, and probably also the net available external power.

The experiment commenced at 2 p.m. on August 21st, with good fires in both the retort and boiler furnaces, and steam at 30 lbs. pressure, water at mid-glass, and the retort and brickwork all thoroughly hot. The fires had been got up with small coal, but during the experiment were fed only with the cinders and breeze riddled from the dried charges, except on the first day, when the boiler fire was fed with coal, as having a poor draught. This was before it was found that the waste heat from the retort furnace was capable of doing the work, so that as long as the main fire was kept bright, and the temperature of the waste gases above 700° F., no fire was required in the boiler, which was allowed to die out, but was relit on two subsequent occasions, when through a low furnace fire the steam had dropped to or below 20 lbs. The total coal thus used was 1 cwt., but as it was uselessly employed, no deduction for it need be made.

The experiment was stopped at 7 a.m. on August 23rd, with a bright fire in the main furnace, none in the boiler furnace, steam at 30 lbs., and water mid-glass.

The refuse was brought to the yard in six cart loads, and was weighed on a public weigh-bridge, the weights and dates being :—

| | T. | C. | Q. |
|---|---|---|---|
| August 21st, two cart loads, net weight ... | 2 | 17 | 0 |
| " 22nd, " " " ... | 1 | 11 | 2 |
| " 24th, " " " ... | 2 | 9 | 0 |
| Total weight ... ... | 6 | 17 | 2 |

After the experiment there was weighed back 3 tons, leaving the weight destroyed 3 tons 17 cwt. 2 qrs.

The two loads on the 21st were pure midden stuff, and fearfully wet; the two loads on the 22nd were midden stuff, but very much drier and lighter, more like ashbin refuse; the two loads on the 23rd were midden stuff again, but not so wet as on the 21st; practically the stuff destroyed was that delivered on the 21st and 22nd.

The charges, after being drawn from the retort, were riddled through a sieve having ½-inch meshes, and afterwards through a sieve having ⅛-inch meshes. From the ½-inch sieve, tins, bottles, &c., were thrown on to a heap (afterwards weighed), and the material remaining on the ½-inch and ⅛-inch sieves was used for firing, being measured into boxes before use (since to weigh it continuously would have been needlessly troublesome). Of these boxes 63 were consumed, the net weight of each of which was 1 qr. 23 lbs., or a total of 1 ton 8 cwt. 3 qrs. There remained over and above this at the close of the trial 13 cwt. 1 qr.; the total burnable material was then 2 tons 2 cwt. The riddled dust weighed 16 cwt. 1 qr. 17 lbs.; the pots, crockery, &c., 2 cwt. 1 qr.; the clinkers, 7 cwt. The ashes were tipped as drawn, and were unfortunately not weighed.

The balance-sheet would therefore be :—

| | | qrs. | p.c. |
|---|---|---|---|
| Midden stuff treated, 310 qrs. | Used as fuel ... ... | 115 | 37 |
| | Fuel remaining over ... | 53 | 17 |
| | Dust ... ... ... | 66 | 21 |
| | Pots, crockery, &c. ... | 9 | 3 |
| | Clinkers ... ... | 28 | 9 |
| | Ashes, water, &c. (by difference) ... | 39 | 13 |

Contrary to what might have been expected, the burnable material is only 54 per cent. of the total, which is a good deal lower than in London ashbin refuse. It will be seen that the fuel remaining over and above is 17 per cent. of the total weight treated, *i.e.*, 3·4 cwt. per ton.

I propose, as soon as possible, to establish the evaporative value of this material compared to coal, but taking it at one quarter (which, I believe, is below its value), then 1 ton of the midden stuff treated yields over and above the fuel necessary for its inoffensive destruction, the equivalent of 0·85 cwt. of coal, and reducing this to the form "evaporative value compared to coal," 20 cwt. of midden stuff is equivalent to 0·85 cwt. of coal, which gives an "evaporative value compared to coal" of 0·04, or say, $\frac{1}{25}$th (provisionally).

The total water evaporated was 4,300 lbs., or 66 lbs. per hour; but the figure is of little value (except to show that the boiler was not over-worked), because for part of the time I had a steam jet in the chimney to increase the draught. The actual water consumed by the jet alone was 50 lbs. per hour.

These experiment have been since repeated for 70 hours, but the results must stand over till next week. The expected increase of output has been obtained; but the net available external power has not been increased.

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ERRATUM.—In the last article, in the sentence "from which it appears there is a substantial return in power from the use of the *town* cremator," for "town" read "Jones."

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## REVIEW.

*Griffin's Electrical Price-Book.* By H. J. DOWSING, M.I.E.E. London: Griffin & Co., Limited.

This work is compiled from price lists of leading manufacturers, and will be specially of service to installation firms, architects and consulting engineers, saving time and trouble in going through many lists to ascertain and compare prices. Together with the prices, some notes of information and description are given under the various headings. These are, as a whole, valuable; in a few cases, however, they are out of place altogether, for instance, in estimating the price of "Generating Station Buildings," no company or corporation requiring a generating station would ever think of consulting a price-book on the subject. Submarine cables would never be looked for in a price book, yet here we find them estimated at from £200 to £300 per mile. Submarine cables are not articles enquired after everyday, and a price-book would never be consulted by an intending purchaser of an Atlantic cable. The Edison-Swan Company are stated to be the sole makers of incandescent lamps in the United Kingdom, and only the Edison-Swan price lists are quoted. It is well known the prices of incandescent lamps will be very much modified in a few months, so the prices in this list will then be useless. In other price-books "export" price lists are given in which lamps are quoted at about half the prices given here; these "export" price lists are omitted in this book.

The price lists given and lists for everyday electrical requirements are correct and full, and, made up in this handy form, are very convenient in making out approximate estimates for contracts and supplies. The arrangement is very good, although the lists of smaller supplies might have been more numerous, as it is chiefly on the prices of small supplies that such a work is consulted. The book is well printed and bound, and of a very handy size for reference.

## TEST OF A TRIPLE EXPANSION ENGINE.

MESSRS. C. F. PEABODY and E. F. Miller are responsible for the accuracy of the figures given of a triple expansion engine test made by the students of the Massachussetts Institute of Technology, from which they draw certain conclusions. The engine in question has cylinders of 9 inches, 16 inches and 24 inches diameter, by 30 inches stroke, with provision for jacketing heads and barrels; with a surface condenser, cranks at 120°, and steam 98·9 per cent. dry; the test having as object to show the effect of the jackets. Tests were made (*a*) with steam in the cylinder jackets, but not on the receivers; (*b*) with the receivers also jacketed; (*c*) with individual cylinders jacketed.

The highest economy was shown by the tests (*a*) when the test performance was secured with a 30 per cent. admission in the first cylinder; the cut-off in the other cylinders being set to avoid drop between the cylinders.

The final steam was practically dry, but was wetter at release than at cut-off in the final cylinder, showing condensation during expansion—an unexpected result.

The series (*b*) appeared to show that the application of heat in the jackets was in excess, and that it would have been well to reduce the temperature of the later jackets.

Tested with no jacket, steam showed a difference of 11 per cent. more steam per H.P. as compared with series (*a*), and the steam becomes progressively wetter as it passes through the engine.

Very little difference is shown as between a jacket on the final cylinder alone, or on the intermediate cylinder, but in either case a distinct advantage was found with the jacket, more so than when the jacket was applied to the receivers.

It was concluded that it mattered little whether a jacket, when only one was used, was applied at the H.P. or the L.P. end of an engine, nor whether the first or second receiver was jacketed in combination with jackets on the two last cylinders. The general conclusion is that jacketing should be carried far enough, and not too far, and that then it matters little where they are applied. The final steam, of course, must not be superheated, as it seemed to be when all the cylinders and receivers were jacketed.

## THE USE OF CUPRIC NITRATE IN THE VOLTAMETER, AND THE ELECTRO-CHEMICAL EQUIVALENT OF COPPER.*

BY FREDERICK E. BEACH.

THE object of this paper is to show that cupric nitrate has some marked advantages over the sulphate.

The apparatus used in the experiments was, briefly, as follows:—The anode was made from a piece of electrolytic copper, about 2 mm. thick, by bending it so as to form three sides of a rectangle. This was immersed in copper nitrate contained in a glass beaker. The cathode was usually a thin sheet of platinum, though copper was occasionally substituted for it. The current was measured by the silver voltameter when small, and a Thomson balance in a few instances, when the total current was large. The value of the equivalent of silver used in calculating the numbers hereafter given was 0·0011181, the mean of the value 0·0011183 found by Kohlrausch,† and 0·00111794, the one given by Rayleigh.‡

It was found, early in the course of the work, that when the nitrate solution was freshly prepared, it had a tendency to dissolve copper, and that this tendency, which was due to the solvent action of the solution itself, or the presence of a small quantity of free acid, decreased after the copper electrode had been kept in the solution a sufficient length of time, and that this latter effect seemed to be facilitated by the passage of the current. On the other hand, another difficulty to be contended with was the oxidation of the copper deposited after the solution had been used too many times, or the current was pushed too far, causing, in many cases, a darkening, or even perceptible blackening of the metal. It was, however, discovered that the blackening due to oxidation could be prevented by the addition of a small amount of ammonium chloride.

Having obtained a fair control of both the tendency to oxidation and solution, experiments were undertaken with a view to determining the value of the electro-chemical equivalent. The solutions used in obtaining the numbers given in the first series were alike in that they were neutral with respect to the copper, and contained $NH_4$ Cl.

| No. | First series equivalent × 10⁷. | No. | Second series, equivalent × 10⁷. |
|---|---|---|---|
| 1 | 3,291 | 33 | 3,294 |
| 2 | 3,291 | 34 | 3,296 |
| 3 | 3,293 | 35 | 3,299 |
| 4 | 3,293 | 36 | 3,293 |
| 5 | [3,305] | 37 | 3,295 |
| 12 | 3,296 | 38 | 3,294 |
| 13 | 3,297 | 39 | 3,296 |
| 14 | [3,305] | 40 | 3,298 |
| 15 | 3,293 | 41 | 3,293 |
| 16 | 3,294 | 42 | 3,291 |
| 17 | 3,296 | 43 | 3,292 |
| 18 | 3,294 | 44 | 3,302 |
| 19 | 3,292 | 45 | 3,296 |
| 20 | 3,300 | 46 | 3 293 |
| 21 | 3,299 | 47 | 3,294 |
| 22 | 3,299 | 48 | 3,291 |
| 23 | 3,291 | 49 | 3,292 |
| 24 | 3,295 | 50 | 3,293 |
| 25 | 3,294 | 51 | 3,292 |
| 26 | 3,292 | 52 | 3,293 |
| 27 | 3,300 | 53 | 3,292 |
| 28 | 3,292 | 54 | 3,291 |
| 29 | 3,296 | 55 | 3,298 |
| 30 | 3,301 | ... | ... |
| 31 | 3,291 | ... | ... |
| 32 | 3,2 5 | ... | ... |

The mean of the first series, including Nos. 5 and 14, is 3295·6 ± 0·54. If these experiments be excluded, we get 3294·8 ± 0·43.

Neutralisation of the solution in the experiments described had been effected by repeated use. A readier method which suggested itself was to boil the nitrate in order to expel the air, allowing a piece of clean copper to stand in the hot solution until its solvent action had been exhausted. Such solutions were prepared, and after the addition of a small amount of $NH_4$ Cl, yielded values tabulated in the second series, the mean of which is 3293 9 ± 0·4.

It is natural to enquire how the values found agree with the equivalent calculated from the atomic weight of copper.

The last-named quantity has been investigated with great care by T. W. Richards*, with the following result:—

If silver be taken as 108·00, oxygen as 16·000, and bromine 80 007

| From | | he finds | |
|---|---|---|---|
| | Cu : 2 Ag | | Cu = 63·640 |
| | Cu : (2 Ag. Br) | | Cu = 63·648 |
| | $CuBr_2$ : 2 Ag | | Cu = 63·643 |
| | | | Cu = 63·644 |

whence we get

$$\frac{Cu}{2\,Ag} = 0\,29465,$$

and Cu equivalent = 0·00032944
when silver is taken = 0·0011181

Hence the value here found is substantially in accord with Richards's.

Further experiments were tried to determine the effect of variations in the temperature. A considerable change of temperature either up or down seemed to favour oxidation, but more particularly the latter, probably on account of the increase in concentration of the salt when cooled. Still even this was in great measure prevented by a sufficient addition of the ammonium chloride.

| No. | Solution. | Temperature. | Equivalent × 10⁷. |
|---|---|---|---|
| 56 | Cu 2 $NO_3$ with $NH_4$ Cl. | 19° | 3,296 |
| 57 | Same. | 6 | 3,297 |
| 58 | Same. | 34 | 3,292 |
| 59 | Same. | 29 | 3,321 |
| 60 | Another solution. | 18 | 3,291 |
| 61 | Same. | 36 | 3,297 |
| 62 | Same. | 37 | 3,296 |
| 63 | Same. | 6 | 3,313 |
| 64 | Same. | 10 | 3,307 |
| 65 | A different solution. | 40 | 3,291 |
| 66 | Same. | 10 | 3,292 |

From these experiments we may conclude that a moderate change of temperature is not a critical matter.

The first and second series were made at the temperature of the room which did not vary much from 19° C.

The following method is recommended for the preparation of the solution:—Dissolve copper nitrate, the purest obtainable, in distilled water. Boil for a short time to expel the air and keep at a temperature of 100° C. for an hour or two in the presence of bright metallic copper in order to completely neutralise the solution. When ready for use it should have a density of about 1·53. Add a saturated solution of $NH_4$ Cl at about the rate of 1 drop to 100 cc. of the nitrate. Just the proper amount of ammonium chloride it is not easy to specify. If too much be present the deposit will discolour

* Abstract from the *American Journal of Science*, Vol. xlvi., August, 1893.

† *Wied. Annal.*, xxvii. p. 17, 1886. ‡ *Phil. Trans.*, p. 439, 1884.

* "Proc. Amer. Acad.," xxiii., p. 177. Ibid., xxv., p. 212.

on drying; if too little, bubbles will collect on the cathode or the deposit will oxidise in the solution. Perhaps the surest way is to try a preliminary experiment, adding the $NH_4Cl$ till the plate begins to show discolouration on drying.

If the solution is to stand the anode may be left in it. Care should be taken to exclude the air.

On removal from the solution the cathode should be washed thoroughly in running water and drained until it may no longer be said to be wet, after which gentle heat should be cautiously applied until all moisture is removed.

The advantages possessed by the nitrate may be enumerated as follows:

1. The weight of copper deposited does not appear to depend on the current density.

2. It permits the use of a high current density.

The limit is not easily stated. When 0·25 ampères per square centimetre is reached the cathode needs watching, for it will fringe at the edge but does not become powdery.

No way was found to prevent the branching with a high current density.

A greater amount of $NH_4Cl$ should be present when the current density is increased.

3. The weight of copper is practically independent of the temperature between 10° and 35° C.

The tendency to oxidation is increased by lowering the temperature, but this may be easily counteracted by the addition of more $NH_4Cl$.

4. The solution may be used a number of times.

5. The equivalent agrees to four figures with that calculated from the best chemical determinations, viz.:

| | | |
|---|---|---|
| Richards | Eq. $=$ | $(3294{\cdot}4 \pm 0{\cdot}1) \times 10^{-7}$ |
| First series | Eq. $=$ | $(3294{\cdot}8 \pm 0{\cdot}43) \times 10^{-7}$ |
| Second series | Eq. $=$ | $(3293{\cdot}9 \pm 0{\cdot}39) \times 10^{-7}$ |

The purity of the nitrate as a condition of success is to be emphasised. One specimen tried, which contained nitrite, was absolutely worthless with the foregoing treatment.

To see what $CuSO_4$ would do under circumstances similar to those in which the nitrate was studied, a saturated solution of the sulphate was rendered neutral by the copper hydrate precipitated on addition of ammonia. $NH_4Cl$ was added until the deposit was as bright and lustrous as that formed in an acid sulphate solution.

Three such experiments yielded

$$\text{Eq.} = 3295 \times 10^{-7}$$
$$\text{Eq.} = 3293 \times 10^{-7}$$
$$\text{Eq.} = 3294 \times 10^{-7}$$

Two other experiments in circuit with the nitrate showed

| | | Sulphate. gms. | Nitrate. gms. |
|---|---|---|---|
| Copper deposited | ... | 0·4722 | 0·4719 |
| " " | ... | 0·5671 | 0·5667 |

These values tend to confirm the result obtained from the nitrate; at least they do not contradict it.

## TELEPHONES AND THE GLASGOW CORPORATION.

AN important memorandum with reference to the contract now in course of negotiation between the Post Office and the National Telephone Company, relating to the telephone system, has been issued by Mr. Robert Starke, the convener of the Telephone Committee of the Glasgow Corporation:—

1. This contract is directly aimed against the Corporations, County Councils and local authorities throughout the country.

2. All the telephone patents of importance have expired, which leaves the telephone service open, but it cannot be carried on without a license from the Postmaster to do so. Thirteen licenses were issued, all of which have now been bought up by, or are under the control of, the National Telephone Company. They have by this means, therefore, re-established their monopoly, which formerly existed only by their possession of all the patents.

3. On May 23rd last the Treasury issued a minute, setting forth the intended future policy of the Government with respect to the telephone system, and in this minute they stated that their object was to comply with the reasonable demands of any town or district for telephonic facilities, and to meet as far as possible the views of municipal authorities by placing additional telephonic facilities at the disposal of the public.

4. In order to carry out the policy of the minute, the Telegraphs Bill was introduced on the eve of the dissolution of last year, authorising the Treasury to apply one million pounds sterling for the purpose of buying the inter-town trunk lines and the erection of additional trunks. This Bill was referred to a Special Committee. After three sittings and hearing five witnesses, two of whom were from the Post Office and three from the telephone companies, they issued a special report. As the Committee met on the eve of the dissolution, adequate examination and inquiry were impossible. The Treasury minute expressly sets out the intention of the Post Office to co-operate with and assist municipal and local authorities, but no witness was called by the Committee from any corporation, county council, local authority, or anyone representing the telephone-using public. The Committee, therefore, dealt only with one point—namely, the term of years for which the existing licenses had been granted, and they recommended that this should not be extended. In reference to other points and details about which, although they said they were of considerable importance, the Committee made no report and gave no opinion, as they had heard no evidence, they said these might properly "form the subject of negotiations between the companies and the Department," and added a recommendation that any agreement made with the telephone companies was to be laid before Parliament.

5. The Act of last year went far beyond the policy indicated in the Treasury minute. By section 5 the Postmaster may authorise any telephone company to exercise all the powers he has himself under the Telegraph Acts of 1863 and 1878. This is a direct attack upon the present position of corporations, no representative of whom had any opportunity whatever of considering the Bill. The Bill was rushed through in the last days of Parliament. Sir John Lubbock in the House of Commons, and Lord Hobhouse in the House of Lords, protested against the way in which it was rushed through, and pointed out that although the London County Council would be directly and seriously affected by the Bill, they had been entirely ignored, and denied any opportunity of protecting their own interests.

6. In pursuance of the policy indicated in the Treasury minute, the Corporation of Glasgow have applied to the Postmaster for a telephone license in order to establish a municipal telephone service. In their application they state that the Glasgow Corporation own their own street tramways, their gas and water supply and mains, their hydraulic power, also their electric light supply, and that no person or company, except the corporation, has any right to interfere with the streets of the city, and as an adequate telephone service must be laid underground, the control of such an undertaking should be in the hands of the corporation, as the opening of their streets would interfere with their drains, sewers, hydraulic works, gas, water, and electric light mains and piping. The condition of Glasgow is entirely different from London and many other cities, inasmuch as the corporation control and supply everything relating to public facilities, whereas in London these undertakings are all in private hands. The Glasgow Corporation, in seeking this license, is therefore carrying out the policy which they have always followed, and which has again and again been given effect to by Parliament, not only by the special legislation relating to the city itself, but in the general Acts for local authorities to establish gas, water and electric lighting works, and to become owners of street tramways, &c., within their jurisdiction, as in their judgment a telephone service could be more properly supplied by the corporation than by any private person or company.

7. The Glasgow Corporation being without any definitive reply from the Postmaster to their application for a license, a deputation from the corporation had an interview with the Postmaster on Wednesday last, but could obtain no promise from him. (*a*) To grant the corporation a license to establish municipal telephones, or (*b*) to disclose the terms of, or to lay the proposed contract between the National Company and the Post Office on the table of the House before being ratified, as recommended by the committee which reported on the Bill last year; or (*c*) to consent to the appointment of a Select Committee of the House of Commons to enquire and report on the proposed arrangements between the Post Office and the telephone companies, and generally on the future policy of the Post Office with reference to the extension of the telephone service. The Postmaster informed the deputation that, before considering the question of any new licenses, he would conclude the agreement with the National Telephone Company for, amongst other purposes, the purchase of their inter-town trunk lines.

8. The National Telephone Company has absorbed all the other companies, and is now the only telephone company in active operation. The share capital is about £2,500,000 (not including preference and debenture capital). The particulars of how more than three-fourths of this £2,500,000 was appropriated can be ascertained from the prospectuses and amalgamation agreements of the National and the other companies.

9. The Postmaster, therefore, intends to conclude an agreement with the National Telephone Company, which in its terms is certain to be an invasion of the rights, present or future, of the London County Council, and of every corporation in the country. Mr. Hunter, solicitor to the Post Office, told the committee that it is their policy not to limit the charges made by their licensees. The agreement will, therefore, practically make the Post Office and the National Telephone Company partners in the telephone service, and will debar any other service from being possible, and will enable the company to continue the present excessive charges in order to pay dividends and provide a sinking fund on, and for, millions of capital which are largely unrepresented by any property of any kind. On this point Mr. Lamb, of the Post Office, in his evidence before the committee last year (see questions 123, 124 and 125) said that the National Company's capital might be taken at £4,000,000, that 19 years hence, when their license expired, their existing plant would not be worth more than about £1,000,000; that they had no reserve fund, and that, therefore, they ought to be setting aside now a sum to place them in possession of £3,000,000 at the end of 19 years. This is the Post Office official's own statement as to the position of the National Telephone Company, and the sum of £3,000,000 can only be obtained by making excessive charges to the public.

10. In the Treasury minute of last year it is laid down that no license will be issued to any company unless it provides a double wire service, without which no city can be adequately telephoned. Notwithstanding this the Post Office are making a contract with the National Telephone Company, which has a single-wire system, obsolete and worthless for modern telephony, and which has been condemned by the Post Office Department itself and by every writer on the telephone question. This will prevent any improvement of the service in the large cities. The National Company's system must be entirely reconstructed, further capital will have to be raised for this purpose, and the telephone using community will be taxed to

pay dividends upon it, the position of the telephone community being thereby made infinitely worse than it is at present. The service in large cities is not only condemned by every user, but it is condemned by the National Telephone Company itself. The chairman of the company told the committee last year (see question 366) that their company "had about 93 per cent. or 94 per cent. of the whole of the telephonic business of the country, and conducts a great deal of it monstrously badly," and further added, "Take London for instance. London is very badly served." He ascribed this to want of statutory authority. The true reason is, that instead of applying the capital to provide an adequate service, it was otherwise appropriated. If this company, without any statutory authority, raised and applied millions sterling to purposes other than those for which the company was expressly created, the question arises, how much would they have raised and applied in this way if they had possessed statutory powers? And assuming the contract is made with the Post Office, which will confer upon them a monopoly and a partnership with the Government, the further question arises, how much capital will they in the future raise for the same purposes, to which they have already applied about £2,000,000, all the accumulations of which are to form a tax on the community? The power and inclination to create promotion capital is as strong now as ever it was; indeed a large sum was created last year in connection with obtaining the control of the New Telephone Company.

11. On account of the National Company interfering with local authorities establishing electric light installations or working tramways by electricity—because they might interfere with their obsolete single-wire telephone service—a Select Committee of the House of Lords and House of Commons was recently appointed to consider and report whether the grant of statutory powers to use electricity ought to be qualified by any restrictions as to earth return circuits, or by any provisions as to leakage, induction, or similar matters, and if so, in what ways and under what conditions. The following recommendation is taken from their report:—"The committee are of opinion that it is desirable in every way to facilitate the use of insulated metallic circuits for telephones, and for this end they recommend that statutory powers be granted enabling undertakers to lay their wires underground." In the above recommendation the term "undertakers" is used in the same sense as in the Electric Lighting Acts, where the local authority is defined to come within the meaning of the term "undertaker," and preference is to be given to a local authority desiring to become an undertaker. This shows clearly that the joint committee carefully used words bearing this construction, and avoided those which might be construed to mean only the National Telephone Company, or any other private person or company.

12. The information is full and conclusive as to what an adequate double-wire underground service can be supplied for. In every European country which has not been hampered by such an organisation as the National Telephone Company, with enormous capital only in part represented by property, the telephone service is cheap and excellent. Many examples could be given, but it will be sufficient to refer to the telephone system of Stockholm where the charge is £4 8s. 11d. per annum, with a capital outlay of £2 15s. 7d., which makes a total annual rental of less than £5. For this the subscribers have a right to speak within a radius of 70 kilometres, or nearly 40 miles. The Stockholm service is described by consuls and telephone engineers in the highest terms. The plant, both indoor and outdoor, is of the best description, and conversation is loud, distinct and free from disturbing noises. Full information in respect to the Stockholm telephones is in the possession of the Postmaster-General, who is therefore well aware of what can be done with perfect ease in our cities. No one would attempt to describe our present telephone service in the terms employed by those who have examined the system in Stockholm, and yet the charge in Stockholm is less than one-quarter of that made by the National Telephone Company for its London service. The result of this is shown in the number of persons who use the telephone in Stockholm, as compared with those who use it in our own cities, which are shown in the following table:—

| | Population. | Telephone subscribers. | |
|---|---|---|---|
| Stockholm ... ... | 228,000 | ... 8,400 | 1 sub. to 27 of population. |
| Glasgow ... ... | 814,000 | about 3,000 | „ 271 „ |
| Manchester & Salford | 703,479 | „ 2,700 | „ 260 „ |
| Liverpool ... ... | 517,951 | „ 3,600 | „ 144 „ |
| London ... ... | 4,550,000 | „ 7,000 | „ 650 „ |

13. To the London County Council especially, the attitude and expressed intentions of the Postmaster are very serious. The council has recently adopted the policy of northern cities, of controlling their own public undertakings, by purchasing the first section of their tramways, but instead of the Government through the Postmaster assisting London in the municipalisation of public undertakings, his intention is to shut them out from being able to deal with their telephone service for the whole 18 years for which the National Company's license has still to run.

14. Edinburgh and Aberdeen have also decided to apply to the Postmaster for a license to establish municipal telephones. Manchester and other cities are considering the question. A united movement is, therefore, possible, but London as the capital, should take immediate steps to protect its own interest, and join in what would then become a general movement. Meantime, Glasgow is entitled to look for the support of all the other corporations in obtaining a license to provide and work its own telephone service.

15. A grave crisis has thus arisen in reference to our future telephone system, which demands the immediate and careful consideration of members of Parliament, of the London County Council, and of all corporations and local authorities throughout the country, and unless steps are at once taken to prevent this proposed agreement being concluded with the National Telephone Company, local authorities will find themselves hampered in their work, and the community saddled in perpetuity with a liability to pay charges calculated on the enormous capital created by the National Telephone Company, only a part of which has been expended on plant and property. It is therefore suggested that a joint movement should be at once organised with the object of defending the public rights.

## NEW PATENTS—1893.

15,781. "An improved system of electric wiring." T. P. RENNOLDSON. Dated August 21st.

15,784. "An improvement in electropathic body belts." J. C. SIMMONDS. Dated August 21st.

15,789. "An automatic method of starting and stopping the paper of Morse telegraph or other recording instruments." J. P. GORTON. Dated August 21st.

15,906. "Improvements in and relating to electrolytic apparatus." D. YOUNG. (Communicated by La Société Outhenin Chalandre Fils & Cie.) Dated August 22nd. (*Complete.*)

15,907. "Improved insulator for telegraph and telephone wires." H. KOSTER. Dated August 23rd.

15,933. "Improvement in telephones." A. SPARK. Dated August 23rd.

15,957. "Improvements connected with assistant or auxiliary electromotors." LA SOCIETE ANONYME POUR LA TRANSMISSION DE LA FORCE PAR L'ELECTRICITE. Dated August 23rd. (*Complete.*) [Date applied for under Patents, &c., Act, 1883, Sec. 103, March 15th, 1893, being date of application in France.]

15,963. "Improvements in electric indicators." B. ZEITSCHEL. Dated August 23rd. (*Complete.*)

15,971. "Electro-magneto motor for maintaining uniform speed." G. L. ANDERS and W. KOTTGEN. Dated August 24th.

15,974. "A new form or construction of tube or pipe for carrying or supporting electric wires underground." J. J. GREEN and W. OATES. Dated August 24th.

15,997. "Improved electric high tension fuse head for use in blasting." T. MALSON, S. R. MALSON, W. A. MALSON and E. SMITH. Dated August 24th. (*Complete.*)

16,000. "Improvements in telegraphy." C. A. ALLISON. (Communicated by P. J. Wicks, United States.) Dated August 24th. (*Complete.*)

16,008. "Improvements in or relating to multiple telegraphy." A. PIEDFORT. Dated August 24th. (*Complete.*)

16,017. "Improvements in electrically-actuated machine tools." H. W. GIBBS and G. J. GIBBS. Dated August 24th.

16,019. "Improvements in metal posts or supports for electric wires or cables, also applicable for other purposes." O. ANDRE. Dated August 24th. (*Complete.*)

16,025. "Automatic coupling for electro-motors." SIEMENS BROS. & CO. LTD. (Communicated by Siemens & Halske, Germany.) Dated August 24th.

16,026. "An automatic regulator for dynamo-electric machines." SIEMENS BROS. & CO., LTD., and E. HOLMES. Dated August 24th.

16,027. "Improvements in connections for local supply from electrical mains." SIEMENS BROS. & CO., LTD., and H. G. KNORR. Dated August 24th. (*Complete.*)

16,028. "A method of compensating variations of load at electrical stations." SIEMENS BROS. & CO., LTD. (Communicated by Siemens and Halske, Germany.) Dated August 24th.

16,033. "Means and apparatus by which drawings, plans, maps, charts, music, writings, shorthand and other written or printed matter can be telegraphed over a single line of wire." R. J. CROWLEY and H. W. C. COX. Dated August 24th.

16,060. "Improvements in electric arc lamps." G. T. PARDOE and G. BROUGHALL. Dated August 25th.

16,074. "Improvements in apparatus for lighting gas by electricity." A. GEYER and J. STEGMEIER. Dated August 25th. (*Complete.*)

16,133. "Improvements in electrical devices for opening doors." W. P. THOMPSON. (Communicated from H. Schütze, Germany.) Dated August 26th. (*Complete.*)

16,136. "Improvements in or relating to electrodes for primary and secondary batteries." A. J. BOULT. (Communicated by R. T. E. Hensel, Germany.) Dated August 26th. (*Complete.*)

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

43. "Improvements in apparatus for electric lighting of railway trains." E. J. HOUGHTON and W. WHITE. Dated January 1st. A dynamo is placed in the guard's van and driven by a belt from an axle of the van; brush holders are attached to the dynamo in such a manner, that they are free to travel round the commutator. A centrifugal governor, working with the dynamo, causes the brush holders to move forwards as the speed of the dynamo increases, and to move backwards as the speed diminishes, thus altering the lead of the brushes to suit the speed. The brushes, made preferably of layers of

copper wire gauze, are pressed by springs against the commutator, and by their friction are, with their holders, carried round a portion of the commutator sufficiently far to be in suitable position for running in either direction, and this movement of the brushes reverses the polarity of the field of the dynamo by means of a switch, and thus ensures a similarity of current in whichever direction the dynamo armature revolves. A high resistance solenoid is connected to the terminals of the dynamo, and to a contact operated by the governor. The governor, at a pre-arranged speed, closes the solenoid circuit, whereupon the core of the solenoid closes the dynamo and accumulator circuit, causing the former to charge the latter. In the circuit of the lamps is a regulator, consisting of a solenoid with an iron core, having attached to it some resistance wire wound in the form of a spiral conical bed spring, and arranged in such a manner that when the solenoid is excited, the core lets more or less resistance into the lamp circuit when the dynamo is acting, taking the resistance out when the dynamo ceases to charge. 3 claims.

207. "An electric regulator." E. J. HOUGHTON and W. WHITE. Dated January 5th. A wire, preferably of metal of comparatively low conductivity, such, for instance, as German silver, is bent into the form of a spiral or volute of many convolutions, and is laid on a plate of good conducting metal, such as copper, to which the outermost convolution is fixed, and to which also one of the circuit conductors is connected. The other conductor of the circuit is connected to the central convolution of the coil through the coil of a solenoid, which, as well as the volute coil, may thus form part of the circuit to be regulated, or which may be in a shunt. The central convolution of the volute is connected to the core of the solenoid, the attraction on which is suitably counterpoised by an adjustable spring, so that when the current in the circuit or its electromotive force is normal, a number of the inner convolutions of the volute are lifted off from the plate in the form of a cone, these convolutions constituting a certain resistance. 1 claim.

259. "A method of utilising electrical energy for the heating of water and other liquids." A. B. WOAKES. Dated January 6th. The inventor places in a tank or receiver, of any material capable of withstanding the heat of boiling water, two electrodes or two sets of electrodes, of carbon, platinum, or other suitable conductor held in position by any suitable means, one electrode being in electrical communication with one of the conductors supplying the current, the other electrode being in communication with the other conductor. In order to regulate the heat at which the fluid is to be maintained, or to increase the rapidity of heating or boiling, he causes one of the plates to be moved in such a manner that the distance between the two, or depth in the fluid, can be varied at will. 4 claims.

359. "An improvement in dynamo-electric machines." SIEMENS BROTHERS & CO., LTD., JOHN NEBEL, and W. A. COLLINGS. Dated January 7th. Claim:—In the Siemens alternating current dynamo electric machine, or similar machine with disc armature, constructing the field magnets by providing on each iron frame two circular rows of projecting studs with pole pieces having the coil wound in a circle inside the studs of the one row and outside those of the other, substantially as described.

360. "Appliance for equalising the loads of the several conductors of rotary phase current installations." SIEMENS BROTHERS & CO., LTD. (Communicated from abroad by Messrs. Siemens & Halske, of Berlin.) Dated January 7th. Claim:—In combination with three or more conductors of rotary phase currents supplying services of lamps or other consumers of electricity, an equaliser arranged as a closed magnet transformer with as many coils as there are conductors, each of the coils having its entering wire connected to one of the conductors at a point whence it branches to enter its service, and all the coils having their leaving wires connected together to the leaving wires of all the services, substantially as and for the purpose herein set forth.

372. "Improvements in soldering, melting, and coating metals by the aid of electricity." N. BENARDOS. Dated January 7th. The inventor employs a vessel of funnel-like form which in some cases is provided with a handle; at the bottom of the vessel in the neigbourhood of the orifice there are lips of refractory non-conducting material. The funnel is charged with the solder or other metal to be employed and is connected with one of the terminals of an accumulator or other source of electricity. The other terminal is connected with the article to be soldered or with the plate to be coated or other receiving surface. When the apparatus is in use the electric circuit is completed by the metallic fragments in the funnel-like vessel making contact with the receiving surface at the opening between the refractory non-conducting lips. 2 claims.

475. "Improvements in electric testing apparatus." J. SWINBURNE. Dated January 9th. Claim: The application of artificial self-induction to neutralise the effects of capacity in testing electric conductors, substantially as described.

499. "A new or improved continuous current transformer and method of winding the field magnets of such." F. M. NEWTON and T. HAWKINS. Dated January 9th. The inventors employ, as is usual, a high tension armature and a low tension armature rigidly attached to one another and each with its own field magnet. The said field magnets are compound wound. The series winding of the primary field magnet is in series with the primary armature, the external primary circuit and the generator. The series winding of the secondary field magnet is in series with the secondary armature, the external secondary circuit and the lamps or other apparatus for which the current is supplied. The shunt winding is common to both magnetic circuits, that is to say a coil constituting either the whole or a part of the shunt winding embraces a part of each field magnet, instead of first embracing a part of one field magnet and then a part of the other. The said shunt winding is derived from the secondary circuit. 4 claims.

1,141. "Improvements in dry electrical elements." C. VOGT. Dated January 20th. The improved element consists of two superposed chambers, the lower serving as current producer and the upper to bind the separated ammonium by means of phosphoric acid to phosphate of ammonia, whereby a bursting of the hermetically closed element is prevented. 1 claim.

1,216. "Improvements in electric cut-outs." H. KORTEN. Dated January 21st. The inventor provides a permanent steel or an electro-magnet before the poles of which is suspended an iron armature insulated therefrom, and which, when not attracted by the magnet is lifted away from it by the action of a weight or spring. The current is made to pass through this armature, and on its strength exceeding a certain limit the armature becomes heated and ceases to be attracted by the magnet. 2 claims.

1,641. "Improvements in electro-motors for electrically propelled vehicles." A. SIEMENS. Dated January 27th. Claim:—In electro-motors for propelling vehicles, making each of the pole pieces of the field magnets in parts, the one part hinged, substantially as and for the purpose set forth.

1,734. "An improvement in electric compasses and course recorders." J. VON PEICHL. Dated January 28th. Relates to improvements in the apparatus described in specification No. 1,031 of 1890.

4,709. "An improved method of and means for electric wiring." R. F. YORKE. Dated March 9th. Claims:—1. An improved method of laying electrical wires, consisting of an insulated and covered leading or positive conducting wire, and a separate and distinct return naked conducting wire, both enclosed within a damp-proof and hermetically sealed metallic case, such as gas piping, substantially as described. 2. In such an improved method of laying electrical wires the means for covering and protecting the joints of branch mains, consisting of T or other suitably shaped pieces, split as to one part or throughout, the parts of the said joint-sheaths being soldered to one another, and to the main tubing, after the wires have been metallically closed, thus producing a damp-proof and hermetically closed casing, substantially as described.

10,303. "Improvements in electrical reciprocating tools." W. P. CARSTARPHEN, Jun. Dated May 31st. Relates to an improved electrical tool provided with a reciprocating plunger located and moving within the tubular spools of two coils, or sets of coils, of insulated copper wire, through which a direct current of electricity is alternately passed. 6 claims.

11,104. "Improvements in telephonic apparatus." H. HAMMARLUND. Dated June 13th. Consists of the combination of a telephonic apparatus (microphone and telephone), as they are used in practice for communicating from one station to another, with supplementary devices connected to both the call apparatus and to the receiver, and intended to be acted upon by the current produced in the receiving apparatus when the bell-crank of the call apparatus is rotated, and to give into the microphone of said receiving apparatus certain signals by sounding a bell or sounding springs, or the like, or by putting into action a phonograph, when the owner of said receiving apparatus is not at home or not disposed to answer; said signals may be combined so as to indicate to the person who rung the bell of the call apparatus, at what time or at what date the person whom he was calling will be at home or disengaged. 3 claims.

14,217. "An improved automatic electric heat alarm." F. S. PALMER and L. H. DESISLE. (Under International Convention.) Dated January 9th. Claim:—An automatic electric heat alarm consisting of the combination of a hollow metallic reservoir, a quantity of mercury within said reservoir, a plug constructed of material which is a non-conductor of electricity, partially filling said reservoir, and having a small, downwardly-extending, tubular bore, a conductor wire or spindle supported within and surrounded by said non-conducting plug, and extending to such point as that it may be reached by said mercury when expanded and risen in said tube, a second conductor wire or spindle supported within said plug and in contact with said mercury before said mercury is expanded, the whole in combination with an electric battery having its poles connected with said spindles, respectively, and a bell or other alarm or indicator connected with and operated by said electric battery.

15,813. "Improvements in the formation of junctions for electric mains." A. M. THOMPSON. Dated September 3rd. Claim:—The formation of junctions between insulated electric main cables or wires, and auxiliary cables or wires, by means of clips, substantially as described and illustrated.

16,822. "Improvements in electrolytic apparatus." T. CRANEY. Dated September 20th. Consists in encasing carbon into a cell or cells formed on non-porous and non-conducting material, and confining the electrolytic action of the anode to a segregated portion or portions of the body. The material which forms the cell is made of stoneware, glass, or other like substance unaffected by the action of the current, as well as by the chemical action of the products of electrolysis, and the segregated portions are inclosed or contained in vertical or substantially vertical interstices formed in the walls of a cell, or between the walls of two or more superimposed cells or sections. In this way the disintegration of the segregated portion of the anode will not in any way affect the permanency of the anode. 4 claims.

17,223. "Improvements in or relating to welding or working metals electrically." W. P. THOMPSON. (A communication by C. L. Coffin, of America.) Dated September 27th. Claim:—The described method of electrically heating metal of varying cross section consisting in simultaneously subjecting the metal at different points to the action of separate voltaic arcs, whose heating power varies in approximate proportion to the respective cross sections of the material at the points to which the arcs are applied.

# INDEX TO ADVERTISEMENTS.

**The names of Advertisers, whose announcements are ordered for a series, are entered under any one Heading in this Index free of charge, but if repeated under other headings, 6d. per week is charged for each additional entry.**


**Accumulators.** PAGE
Drake & Gorham ... ...
Electrical Power Storage Co. ... 14
Epstein Accumulator Co. ... 21
J. Stiff & Sons (Boxes only) *Sup.* 9
**Arc Lamps.**—Gwynne & Co. ...
International Electric Co. ...
Johnson & Phillips ... ... 1
Körting & Mathiesen ... *Sup.* 10
The Electrical Company *Sup.* 2
Waterhouse Electric Mfg. Co. ... 2
**Asbestos.**
United Asbestos Co. ... ... 3
**Auctioneers and Valuers (Mechanical).**
Wheatley Kirk, Price & Goulty *Sup.* 7
**Batteries.**
R. Aylmer (Leclanché) ... ... 21
W. H. Baughan & Co. ... ...
India-Rubber Co.... ... ... 22
Johnson & Phillips ... ... 1
Sharp & Kent (Weymersch) ... 6
Telegraph Mfg. Co. ... *Sup.* 1
**Battery Jars.**
J. Bourne & Son ... ... ... 19
J. Stiff & Sons ... ... *Sup.* 9
**Bells.**
Butzke & Co. ... ... ...
General Elec. Co., Ld. ... *Sup.* 6
Sheppard, Allarton & Madeley ...
**Belting.**—F. Reddaway & Co. ...
Webb & Son ... ... ...
**Books.**
Berly's Universal Elec. Directory 18
C. Griffin & Co. ... ... *Sup.* 7
**Cabinet Work.**
W. M. Foxcroft ... ... ... 3
**Carbons.**
H. & F. Chamberlain ... ... 6
Genl. Elec. Co., Ld. (G. Binswanger) *Sup.* 6
Gwynne & Co. ... ... ...
Johnson & Phillips ... ... 1
The Electrical Company *Sup.* 2
**Castings.**—Phosphor Bronze Co. ... 10
**Chemicals.**—G. Boor & Co.... ...
**Dynamos.**
Crompton & Co. ... ... *Sup.* 12
Gülcher Electric Light & P. Co. 19
Gwynne & Co. ... ... ...
J. H. Holmes & Co. ... *Sup.* 7
Johnson & Phillips ... ... 1
Laurence, Scott & Co. ... ... 2
Mather & Platt ... ... *Sup.* 2
Newton Electrical Eng. Works
Roeling & Matthews ... ... 19
Ernest Scott & Mountain ... 15
J. G. Statter & Co. ... ... 8
The Electrical Company *Sup.* 2
Wray Elec. Engineering Co. ...
**Ebonite.**
Harburg I. R. Comb Co. ... *Sup.* 7
D. Moseley & Sons ... ... 9
**Electrical Engineers and Contractors.**
Burbey, Williamson & Joseph *Sup.* 5
British Electric Light Co. ... 15
Brush Electrical Engineering Co. 12
Callender's Bitumen Tel. &c. Co. 7
Charlesworth, Hall & Co. *Sup.* 3
Clarke, Chapman & Co. ... ... 8
Crompton & Co. ... ... *Sup.* 12
Drake & Gorham ... ... ..
Electric Construction Company 9
Elliott Bros. ... ... *Sup.* 12
Gwynne & Co. ... ... ...
India-Rubber & Telegraph Works Co. 22
Johnson & Phillips ... ... 1
Laing, Wharton & Down ...
Laurence, Scott & Co. ... ... 2
Mather & Platt ... ... *Sup.* 2
Paterson & Cooper ... ... 21
Reid Bros. ... ... ... ... 10

**Electrical Engineers, &c.**—*Cont.* PAGE
Russell & Co. ... ... ...
Ernest Scott & Mountain ... 15
Siemens Bros. & Co. ... ... 16
Swinburne & Co. ... ... ... 10
Telegraph Mfg. Co. ... *Sup.* 1
The Electrical Company *Sup.* 2
Western Electric Company *Sup.* 12
**Electric Light Fittings.**
Burbey, Williamson & Joseph *Sup.* 5
Benham & Froud... ... ...
G. Braulik ... ... ... *Sup.* 10
Dorman & Smith ... ... ... 11
Electrical Accessories Co. ... 7
Faraday & Son ... ... ... 12
Genl. Elec. Co., Ld. (G. Binswanger) *Sup.* 6
Lea, Sons & Co. ... ... ... 13
A. P. Lundberg ... ... ... 13
Strode & Co. ... ... ... 3
The Paiste Switch ... ... 13
The Electrical Company *Sup.* 2
B. Verity & Sons ... ... *Sup.* 1
Walsall Electrical Co. ... ...
Woodhouse & Rawson United *Sup.* 9
**Electricity Meters.**
Jos. Edmondson ... ... ...
**Engines for Electric Light.**
G. E. Belliss & Co. ... ...
Browett, Lindley & Co. ... ... 6
Greenwood & Batley ... ...
Gwynne & Co. ... ... ...
Marshall, Sons & Co. ... ... 19
Premier Gas Engine ... ... 12
Ransomes, Sims & Jefferies ... 3
Stockport Gas Engine ... ...
Willans & Robinson ... ...
**Fibre.**—David Moseley & Sons ... 9
**Fire Insurance.**
Phœnix Office ... ... ...
**Forgings.**—R. Jenkins ... ... 8
**Fuel Economiser.**
E. Green & Son, Ltd. ... ...
**Glass.**
General Elec. Co. (G. Binswanger) *Sup.* 6
**Incandescence Lamps.**
Edison & Swan United E. L. Co.
The Electrical Co. ... *Sup.* 2
Zürich Incan. Lamp Co. ..
**India-Rubber.**
India-Rubber, G. P. & Tel. Wks. Co. 22
D. Moseley & Sons ... ... 9
**Institution.**
Durham College Science ...
Military & Engineering College *Sup.* 8
Owens College, Manchester ...
University College of N. Wales *Sup.* 8
Victoria University, Liverpool ...
**Insulators, &c.**
Bourne & Son ... ... ... 19
Price, Sons & Co.... ... ...
Stiff & Sons ... ... *Sup.* 9
Telegraph Mfg. Co. ... *Sup.* 1
**Iron and Steel.**—Turner Bros. ... 6
**Ladders.**
J. H. Heathman & Co. ... ... 8
**Lubricants.**
E. G. Cockrell & Co. ... *Sup.* 11
W. H. Willcox & Co. ... ...
**Magnet Steel.**—G. P. Wall ... 13
**Manufacturing Electricians.**
Dorman & Smith ... ... ... 11
Elliott Bros. ... ... *Sup.* 12
Gwynne & Co. ... ... ...
Hartmann & Braun ... ... 17
King, Mendham & Co. ... ...
Laurence, Scott & Co. ... ... 2
Mackey, Mackey & Co. ... ...
Mix & Genest ... ... ...
Nalder Bros. ... ... *Sup.* 11
Strode & Co. ... ... ... 3

**Manufacturing Electricians.**—*Cont.* PAGE
Telegraph Mfg. Co. ... *Sup.* 1
The Electrical Company *Sup.* 2
Walsall Electrical Company ...
James White ... ... ...
Woodhouse & Rawson United *Sup.* 9
**Mica.**
Canadian Elec. Insulations Co. *Sup.* 11
F. Wiggins & Sons ... ... 6
**Motors.**
Cuttriss, Wallis & Co. ... ...
Gülcher Electric Light & P. Co. 19
Gwynne & Co. ... ... ...
The Electrical Company *Sup.* 2
**Patent Agents.**—H. Gardner ... 3
J. G. Lorrain ... ... *Sup.* 8
**Platinum.**—Derby & Co. ... *Sup.* 8
**Poles.**
Johnson & Phillips (Wood and Iron) 1
**Porcelain Appliances.**
Dorman & Smith ... ... ... 11
Genl. Elec. Co., Ld. (G. Binswanger) *Sup.* 6
**Porous Cells.**
J. Stiff & Sons ... ... *Sup.* 9
**Pulleys, Shafting, &c.**
J. Bagshaw & Sons ... ...
Gwynne & Co. ... ... ...
**Railway Signals.**
Saxby & Farmer ... ... ... 12
**Screws.**
Automatic Standard Screw Co. 15
Davis & Timmins ... ... 20
**Stabilit.**—The Electrical Co. *Sup.* 2
**Stampings.**—R. Jenkins ... ... 8
**Telegraph Engineers.**
Johnson & Phillips ... ... 1
Siemens Bros. & Co. ... ... 16
Telegraph Mfg. Co. ... *Sup.* 1
**Telephones.**
O. Berend & Co. ... ... ... 17
Collier-Marr Telephone, &c., Co. 12
Gent & Co. ... ... ...
Ch. Mildé & Co. ... ... ...
G. A. Nussbaum ... ... *Sup.* 11
Western Electric Co. ... *Sup.* 12
**Tenders.** ... ... ... *Sup.* 8
**Tools, &c.**
C. Churchill & Co. .. ...
H. Milnes ... ... ... *Sup.* 9
**Turbines.**
Gilbert Gilkes & Co. ... ...
Gwynne & Co. ... ... ...
S. Howes ... ... ... *Sup.* 2
**Vulcanite.**
Harburg I. R. Comb Co. ... *Sup.* 7
**Water Purifiers.**
Stanhope Water Engineering Co. *Sp.* 11
**Wire (Covered).**
Felten & Guilleaume ... ...
Fowler-Waring Cables Co. ... 18
W. T. Glover & Co. ... ... 2
W. T. Henley's Telg. Works Co. 4
London Electric Wire Co. ... 5
W. Rickard ... ... ...
Telegraph Mfg. Co. ... *Sup.* 1
The Electrical Co. ... *Sup.* 2
United Electric Wire Co. ... 6
**Wire (Uncovered).**
Davis & Timmins ... ... ... 20
Phosphor Bronze Co ... ... 10
Ramsden, Camm & Co. ... ... 15
F. Smith & Co. ... ... ... 3
**Wire Covering Machinery.**
Johnson & Phillips ... *Sup.* 9
**Wood Casings.**
Genl. Elec. Co., Ld. (G. Binswanger) *Sup.* 6
J. F. & G. Harris ... ... ... 6
Vigers Bros. ... ... *Sup.* 8
Wood Carving Co. ... *Sup.* 9


MISCELLANEOUS ADVERTISEMENTS *relating to Situations, Articles for Sale and Wanted, &c., &c., appear on Sup.* 7 *(middle of paper).*

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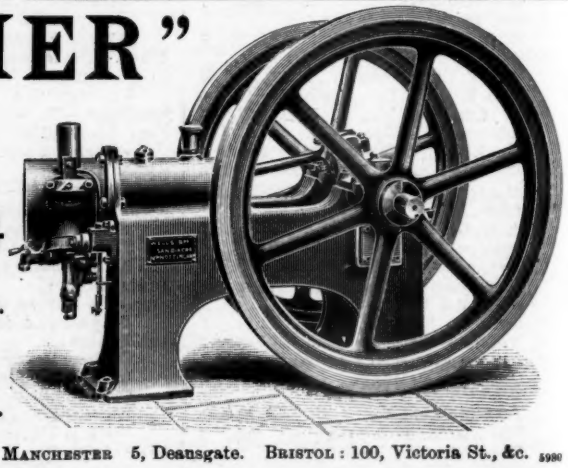

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